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at Victoria

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The Editors Note . . .

NEW YORK's Amateur Astronomers Association recently celebrated its 25th anniversary, and at the dinner on May 10th, George V. Plachy, secretary, gave a five-minute talk from which the following thoughts have been extracted:

Should interest in astronomy be merely a hobby or pastime? Should it be purely an educational pursuit? Should it be a cultural or inspirational activity? I believe it can be all these, and yet something even more significant.

We often hear it said that the perplexities and confusions of life today are largely due to the lagging of the social sciences and the humanities far behind our technological and material progress. Few quarrel with this idea.

In the broad view, then, what are the paths available to us in restoring a world of brotherhood, tolerance, peace and happiness? Let us consider, briefly, some of these paths, from the point of view of universal appeal and effectiveness.

First, the method of general education, of the gradual raising of the level of intelligence of peoples as a whole, moves at an intolerably slow pace in relation to the runaway speed of unsettling elements in international affairs. Second, the arts, such as music, painting, and drama, have essentially an emotional appeal. While useful in themselves, no satisfactory basis of acceptance can be found for their common appreciation and interpretation by all peoples.

A third possible approach, strongly and sincerely held by many, is through religion. While many religions of today have some common elements of belief, it cannot be denied that most orthodox creeds have inflexible boundaries which races of other faiths cannot surmount.

Fourth, there is the United Nations organization, which must of necessity concern itself for many years to come with the simple fundamentals of man's existence, such as a world government, international economic stability, and the like.

Finally, we might seek world tolerance and brotherhood by abstract philosophical inquiry and the paths of pure logic. Yet history teaches us that between men of diverse cultures and experiences there are deep conflicts of ideals and standards.

Is our problem then without solution? I think not. Astronomy, in all its majesty, beauty, and inspiration, lights the pathway of humility and tolerance. But progress must be on a personal basis and, I believe, largely through amateur astronomers. The professionals are of necessity preoccupied with establishing the broad factual basis of the science. But the amateur can communicate his love of astronomy directly to his neighbor. He can impart to his friends that quiet inner enthusiasm, that broadened viewpoint, and that sympathy of understanding which grows out of his own experiences in contemplating the marvels of the universe in which we happen to find ourselves.

The individual amateur astronomer can play a small, but vital and sorely needed, part in promoting tolerance and love of his fellow man. And it is not difficult—just tell others what astronomy does for you.

Sky and TELESCOPE

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Total Eclipse of the Sun — June 30, 1954

THE NEXT total eclipse of the sun visible in the United States and Canada will take place on the morning of June 30, 1954. Whether or not you expect to be in the path of totality, if you are at all interested in eclipses you will want a copy of the booklet, **Total Eclipse of the Sun, June 30, 1954**, prepared by the U. S. Nautical Almanac Office as a supplement to the 1954 **American Ephemeris**. Here is the necessary astronomical data for thinking about the eclipse and for planning an expedition to observe it in either amateur or professional style.

The path of the moon's shadow on this occasion will parallel that of the eclipse of July 9, 1945, but it is considerably farther to the east. Thus it will cross a more accessible and better populated region, both in North America and in Europe. It crosses more land than water, which is unusual. Minneapolis and St. Paul lie close to the center line, as do parts of Upper Michigan's Keweenaw Peninsula. The shadow will fall upon the Indians of Moose Factory and Rupert House at the

foot of James Bay, cut well across the southern tip of Greenland, skirt Iceland, and give the populated regions of southern Norway and Sweden a rare celestial treat. Finally, astronomers in Lithuania, the Ukraine, Iran, and Pakistan will view the sun's corona before the moon's shadow leaves the earth. Totality will last about 1¼ minutes at Minneapolis, and more than two minutes over Greenland, where an airport lies on the central line.

In addition to three maps, there are 11 tables, including those necessary to compute the position of the moon's shadow at various heights in the earth's ionosphere. The supplement was prepared under the supervision of Isabel M. Lewis, and the maps were produced by Simone Daro Gossner.

It is easy to order this 42-page paper-bound booklet from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.; enclose 40 cents in check, money order, postal note, or coin (no stamps) with your request.

C. A. F.

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WHOLE NUMBER 130

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COVER: Dr. Joseph Laughrey, on the left, and Leo N. Schoenig, members of the Amateur Astronomers Association of Pittsburgh, examine a casting molded in the amateurs' workshop at the Buhl Planetarium. On the table is the molding equipment used in the method developed by C. Raible. The photograph is by Messrs. Winterhalter, Schwartz, and Rachuba. (See page 257.)

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BACK COVER: A section of the Milky Way near the Eta Carinae nebula, showing the extent of the emission nebulosity in a 60-minute exposure with the ADH telescope at the Boyden station of Harvard Observatory, Bloemfontein, South Africa. South is at the top. The use of 103a-E emulsion with a red filter accentuates especially the H α emission nebulosity. The original plate was made by W. D. Victor on June 6-7, 1951, and was centered near 11^h 14^m, -60°. Only part of the plate is shown. Harvard Observatory photograph.

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ASTRONOMERS MEET AT VICTORIA

By C. M. HUFFER, *Washburn Observatory, University of Wisconsin*

THE JOINT MEETING of the Astronomical Society of the Pacific and the American Astronomical Society, held June 25-28, 1952, in Victoria, B. C., was one of many contrasts. Victoria greeted the astronomers with sunny skies, but bade them farewell with a typical West Coast rain. The hotels were at sea level, but the sessions were at a higher elevation, one special gathering taking place at the Dominion Astrophysical Observatory on top of a mountain. Temperatures were low for summer, contrasted with the excessive heat at the summer meeting in Washington a year ago. The program of papers was not crowded, and there was plenty of time for discussion.

Only 85 members of the two societies signed the registration book, which made this the smallest meeting of the American Astronomical Society in many years. As President A. H. Joy pointed out, there is always a large attendance for the official photograph. As you can see, there were exactly 117 persons — men, women and children — present for this event in Victoria. Nearly 150 attended the special dinner in the Empress Hotel, including some official guests from the province of British Columbia.

It is difficult to say just when a meeting such as this one starts. Perhaps we should set the initial time as the moment when two astronomers meet on the train or on the boat. This moment came as early as 8 a.m. PST, June 24th, when the *Princess Marguerite* sailed from Seattle, since there were many astronomers on board, although a little time was required for them to find each other. Thus, by the time the ship reached Victoria at 11:50 a.m., the meeting was well under way.

The council meeting was scheduled for the same afternoon at 2:00 p.m. daylight time, but failed to reach a quorum and adjourned to the observatory, where its lengthy session began legally at 5:00 p.m. Dr. Robert M. Petrie, director of the observatory, Dr. Joseph A. Pearce, emeritus director, and Dr. Robert R. McMath, director of the McMath-Hulbert Observatory, soon to be elected president of the AAS, were invited to attend the council meeting. During the evening a recess was called, when council members were served a bountiful supper at the home of Dr. and Mrs. Petrie. After supper, the business meeting was continued until 11 o'clock.

Scientific sessions began the following morning at the Victoria College and Provincial Normal School. The school is about two miles from the business district near Mt. Tolmie (not Ptolemy),

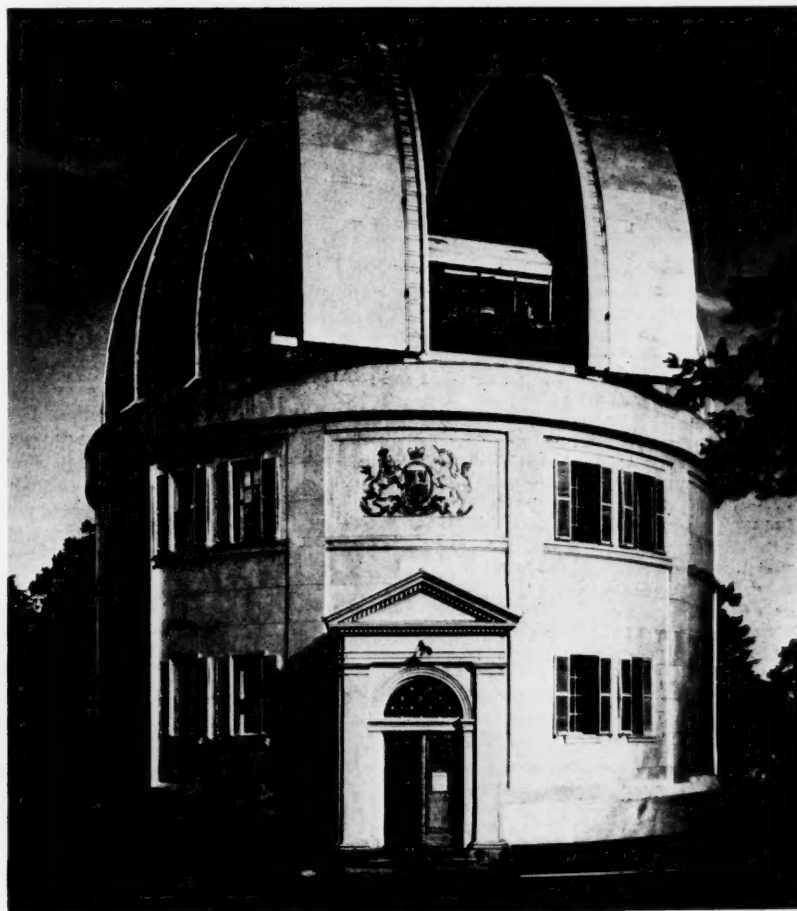
which overlooks the city. Sessions were held in the auditorium, where we had plenty of room, and the convenient halls were easily accessible for informal conversations during recesses. Dr. F. T. Fairey, deputy minister of education for the province, welcomed the societies on behalf of the government, and Dr. Petrie added a welcome from the observatory.

The first highlight of the meeting was the initial lecture in a series sponsored by the Astronomical Society of the Pacific and dedicated to the memory of Dr. Robert Grant Aitken, well-known double star observer, who had twice been president of the ASP and once president of the AAS. This lecture, entitled "Solar Research at the McMath-Hulbert Observatory," was written by Dr. McMath. Unfortunately, he was suffering from a physical ailment and, though present for the lecture, was unable to deliver it himself. Dr. Gerald E. Kron, president of the ASP, intro-

duced Dr. Joel Sebbins, who spoke of the work of Dr. Aitken. Then Dr. McMath's paper was read by Dr. Petrie.

The development of astronomy at the McMath-Hulbert Observatory was described. First a slide of the observatory's original dome, which contained a 10½-inch reflector and spectroheliokinematograph, was shown. (Incidentally, on this slide Dr. McMath was one of the three men shown standing in front of the door.) The dome now contains a 24-inch reflector for use in the exploratory phase of many solar problems.

In 1936, the 50-foot tower contained a solar telescope and spectroheliograph for high resolution of solar prominences. There is now a second solar telescope and spectroheliograph for line-of-sight motions of prominences. The McGregor tower, completed in 1940, and designed for photography of spectra and scanning in monochromatic radiation, is now used for infrared studies with



The 73-inch telescope building of the Dominion Astrophysical Observatory.



Members and guests at the joint meeting of the American Astronomical Society and the Astronomical Society of the Pacific, Victoria, B. C., June 25-28, 1952. Dominion Astrophysical Observatory photograph by S. H. Draper.

photoconductive cells developed during the war years.

The McMath-Hulbert Observatory has long been active in studies involving the measurement of lines in the solar spectrum formerly inaccessible to observation. The new lead-sulfide cells have permitted an extension of the spectrum into the infrared and the determination of the wave lengths of more than 800 formerly unknown lines up to 25,000 angstroms. Further investigations are in progress as far as 50,000 angstroms, and even (with less accuracy) to 100,000 angstroms or 10 microns.

Slides were shown of prominences and flares on the disk of the sun and the resulting motions of material in the solar atmosphere. For example, the great limb flare of May 8, 1951, rose to a height of more than 50,000 kilometers in 90 seconds, and simultaneous spectra in the red line of hydrogen showed large velocity shifts.

The second highlight was a symposium given by three invited speakers on "Spectra of Emission-line Objects." It has been the custom of the AAS for several years to have a symposium of invited papers at nearly every meeting. This time the symposium was given by speakers for Canadian astronomy, the Mount Wilson Observatory, and the Lick Observatory.

The first speaker was Dr. C. S. Beals, Dominion Astronomer, on the subject "Emission-line Objects of Early Type," with Dr. J. A. Rottenberg as co-author. He traced the investigation of these objects from the time of Sir William Hug-

gins in 1864, through the work of Father Secchi, Wolf and Rayet, Keeler and Campbell, to the present. He compared the spectra of the gaseous nebulae to the spectra of early-type stars with bright lines, describing carefully the various classifications.

A theoretical interpretation of the complex emission-line profiles, mainly due to Dr. Rottenberg, was discussed, involving a unified viewpoint that these objects are hot stars surrounded by gaseous envelopes, subject to various kinds of motions. It is possible by the use of complex mathematical equations to adopt a model for the structure of the object and assume internal motions which will permit the computation of the profile of the lines of the spectrum approximating the observed line profiles. Dr. Beals suggested that high temperature alone may be sufficient to produce an object of the Wolf-Rayet or planetary type.

The second speaker in the symposium was Dr. Paul W. Merrill, of the Mount Wilson and Palomar Observatories, whose subject was "Emission Lines in the Spectra of Long-period Variable Stars." Again it is necessary to build a model star, whose mechanism will explain all the details of the spectrum and at the same time relate these details to the light curve. These variable stars are of class *Me*, and stars of class *Ne* are very similar. The phenomena of bright lines are well correlated with the spectral types. The difficulty is that as such a star becomes fainter, that is, has less energy output, the bright lines in

its spectrum become stronger instead of weaker as one would expect. The cycle is as follows:

The bright hydrogen lines appear *after* the star has passed minimum and is increasing in brightness. About halfway up the light curve the lines increase in intensity, reaching their maximum a little after maximum light. They are followed, after a time lag, by the bright lines of metals, especially of iron. This behavior is not symmetrical with the light curve, as many textbooks say, nor are the bright lines symmetrical about any point in time. The dark lines, on the other hand, are to a first approximation a function of magnitude and run through a time sequence in both directions.

Dr. Merrill gave two illustrations which remind us of a Rube Goldberg cartoon. In discussing the behavior of the bright lines as a one-way sequence, he said: "Think of a streetcar that starts from town, changes color, and grows smaller as it proceeds, finally disappearing at the end of the line, never to be seen again. Some time before it disappears, another car starts from town and repeats the same performance. A theory founded on the hypothesis that the streetcar goes out to the end of the track, turns around and comes back, will lead to the wrong conclusion.

"The nature of the problem of a long-period variable may be illustrated by a mechanical analogue. Imagine a complicated machine with many moving parts such as gears, cams, belts, and levers. All sorts of miscellaneous things

KEY TO PHOTOGRAPH

1, J. A. Pearce; 2, Mrs. R. M. Petrie; 3, Mrs. R. E. Williamson; 4, T. P. Maher; 5, Mrs. W. H. Wehlau; 6, Ruth J. Northcott; 7, C. S. Beals; 8, A. McKellar; 9, A. Abt; 10, W. H. Wehlau; 11, Mrs. R. F. Kilby; 12, E. S. Haynes; 13, Mrs. E. S. Haynes; 14, G. M. Clemence; 15, Mrs. G. M. Clemence; 16, O. C. Wilson; 17, K. Hujer; 18, S. M. Bestul; 19, Miss J. K. McDonald; 20, M. H. Wrubel.

21, A. G. Mowbray; 22, S. Edelson; 23, W. Buscombe; 24, R. E. Wilson; 25, Mrs. A. H. Joy; 26, Mrs. G. R. Burbidge; 27, Mrs. H. M. Jeffers; 28, K. Aa. Strand; 29, Mrs. G. E. Kron; 30, F. J. Neubauer; 31, T. S. Vanasek; 32, Mrs. F. J. Neubauer; 33, G. E. Kron; 34, S. G. Hacker; 35, Miss E. L. Scott; 36,

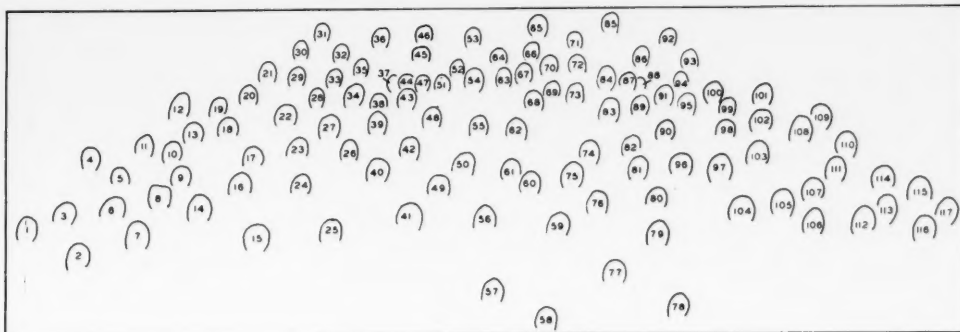
J. L. Climenhaga; 37, Miss R. Jones; 38, A. Poveda; 39, H. M. Jeffers; 40, T. G. Clemence; 41, R. R. McMath; 42, R. H. Garstang; 43, Mrs. S. G. Hacker; 44, C. T. Elvey; 45, Mrs. C. A. Federer, Jr.; 46, John Maybank; 47, A. D. Williams; 48, S. B. Nicholson; 49, Miss L. Clemence; 50, Miss D. M. Laidler; 51, A. Adel; 52, Miss M. Williams; 53, Miss D. M. Fielder; 54, R. Donselman; 55, Mrs. S. B. Nicholson; 56, A. H. Joy; 57, Nancy Irwin; 58, Alan Irwin; 59, Mrs. R. R. McMath; 60, A. H. Mikesell.

61, Miss A. B. Underhill; 62, F. H. Hollander; 63, G. H. Herbig; 64, J. A. Hynek; 65, J. Merner; 66, Mrs. H. J. Smith; 67, G. A. Brealey; 68, Miss W. Sawtell; 69, Mrs. A. Wyller; 70, K. O. Wright; 71, H. J. Smith; 72, G. Herzberg; 73, R. E. Williamson; 74, Miss L. M. Merrill; 75, D. L. Harris, III; 76, Mrs. A. H. Mikesell; 77, Paul Irwin;

78, Kirk Weaver; 79, Mrs. J. Stebbins; 80, Miss E. Irwin.

81, E. A. Carpenter; 82, John Merrill; 83, J. E. Merrill; 84, A. Wyller; 85, W. G. Milne; 86, P. W. Merrill; 87, W. Beardsley; 88, Miss N. E. Gould; 89, Miss N. G. Roman; 90, Mrs. J. E. Merrill; 91, T. S. Jacobsen; 92, R. E. Cornish; 93, O. Struve; 94, K. L. Franklin; 95, Mrs. H. Buehner; 96, Mrs. R. J. Trumpler; 97, J. B. Irwin; 98, R. C. Huffer; 99, Helen Pillans; 100, M. Walker.

101, Gibson Reeves; 102, Mrs. J. C. Duncan; 103, R. J. Trumpler; 104, J. Stebbins; 105, Mrs. J. B. Irwin; 106, R. M. Petrie; 107, Mrs. P. Herget; 108, S. W. McCuskey; 109, J. C. Duncan; 110, Robert McCuskey; 111, William McCuskey; 112, C. M. Huffer; 113, Miss Marilyn Herget; 114, Mrs. S. McCuskey; 115, P. Herget; 116, J. W. Chamberlain; 117, C. A. Federer, Jr.



happen: wheels turn at intervals, bells ring, lights of various colors flash on. But the chief occurrence with which all others are in time is the slow rhythmic rise and fall of a vertical rod which extends from the floor above the rest of the apparatus. It is moved by an unseen source of power beneath the floor.

"Now hide the whole machine under a flexible blanket, nearly opaque, and you have a mechanical analogue of a long-period variable. The chief thing you can see is a slow rhythmic rise and fall of a hump in the blanket caused by the motion of the top of the rod; in addition, a few minor motions back and forth in various directions and an occasional bit of color can be dimly seen through the blanket. It would be pretty hard to guess exactly what is going on inside. You would realize that some repeating mechanism was at work, but you could not tell its exact nature and whether it was mechanical, hydraulic or electric.

"Distance is the astronomical blanket thrown over a variable star to prevent us from seeing the component parts. It condenses the vast bulk of the star to a mere pinpoint of light in which no geometrical detail is visible. But the pinpoint has a definite brightness, and this corresponds to the height of the top of the blanket. The photosphere corresponds to the floor through which the power comes; it would be opaque even if we got close.

"The spectroscope cannot quite remove the blanket, but it can tear a few holes, through which we get glimpses of

what is going on inside. While the piston is rising, a blast of hot hydrogen flashes out; a bit later some incandescent iron appears; while as the piston falls a magnesium flare is touched off. What do these fireworks have to do with the rise and fall of the piston? Nature conducts a wonderful museum but she doesn't hand us any printed cards explaining in words of one syllable the relationships of various happenings. We have ourselves to work out the explanation. And I mean work. Perhaps we need the exercise."

The paper concluded with a discussion of the waves inside the star comparable with shock waves. In the outward motion above the photosphere, the acceleration is inward for neutral emitting atoms, corresponding to a gravitational force or to viscosity, but outward for charged emitting particles, with an electric or magnetic force responsible.

The third and final speaker was Dr. George H. Herbig, of Lick Observatory, who discussed "Emission-line Stars in Galactic Nebulosities." Variables of the type called T Tauri stars are found in large numbers in nebulae, which are great clouds of dust and gas scattered throughout our galaxy. There are two theories regarding them: Either they are stars which have wandered around in space and have plunged into the nebulae, or they are newly born stars formed out of the dust and gas of the nebulae.

In order to test these two theories, Dr. Herbig obtained new spectra with the Crossley reflector of the Lick Observatory, supplemented by a few spectra

taken with the 100-inch telescope on Mount Wilson. The results may be summarized as follows:

1. If the T Tauri stars are field stars which have entered the nebulae, we should find more bright-line stars in nebulae associated with star clusters. This was found to be the case for two nebulae investigated. Therefore, these stars appear to have penetrated each nebula, but another interpretation is that the whole star cluster has been formed relatively recently out of the nebula.

2. About 30 bright-line stars in dark nebulae in Taurus and Auriga have been studied. The fainter of these stars were found to be about 10 times brighter than normal stars of their type. This suggests that these stars may not have plunged into the dark clouds.

3. The four brightest T Tauri stars have spectra which are quite unlike those of normal stars.

Dr. Herbig concludes that these stars are *not* normal stars whose presence in the nebulae is the result of accidental encounter, but no clearcut and entirely acceptable decision between the two theories can be made at the present time.

On Thursday, June 26th, a function at the observatory attracted the record crowd for the meeting. A formal plaque honoring the memory of Dr. John Stanley Plaskett, first director of the observatory, had been placed on the 73-inch telescope. It was unveiled by Mrs. Plaskett, a charming lady, who spoke briefly in appreciation of this thoughtful action of the Dominion of Canada.

Dr. Pearce was master of ceremonies;



Dominion Astrophysical Observatory photograph.

he introduced several persons of note, and also spoke of the life and works of Dr. Plaskett.

After the unveiling, a box lunch was served by Mrs. Petrie. This gave an accurate count of those present, just three short of the 225 boxes ordered. (Mathematically inclined readers are invited to calculate the exact number.)

After supper the poor councilors had to go back to work, and there were some astronomers who wished to talk equipment and observing plans with various members of the observatory staff, but all others enjoyed a conducted tour to the famous Butchart Gardens a few miles beyond the observatory. Observations with the big reflector had been planned for later in the evening, but the weather decreed otherwise. Incidentally, the clouds which appeared at this time were the forerunners of a rain which lasted until we had left Victoria.

The dinner Friday was in the Crystal Ballroom of the Empress Hotel. After dinner, President Joy introduced the distinguished guests present, then called on the writer, as secretary of the AAS, to present a resolution of thanks to the hosts, who had done so much for the comfort and pleasure of the members of the societies present. The president then called on Dr. Otto Struve for some brief remarks, after which two motion pictures were shown, through the kindness of the deputy minister of commerce, who was present for the dinner.

At the annual election of the AAS on June 27th, the following officers were named: president, 1952-54, Dr. McMath; vice-president, 1952-54, Dr. Gerald M. Clemence, U. S. Naval Observatory; councilors, 1952-55, Dr. Walter Baade, Mount Wilson and Palomar Observatories; Dr. Bengt Stroemgren, Yerkes Observatory; Dr. Paul Herget, University of Cincinnati.

The meeting ended before noon on June 28th with a final session for papers, and by late afternoon most of the visiting astronomers were on their way home, probably to start preparations for future meetings. The 88th meeting of the American Astronomical Society will be held in Amherst, Mass., December 28-31, 1952.

TERMINOLOGY TALKS-J. HUGH PRUETT

Seattle Fireball

Only occasionally does one of those flying fragments from interplanetary space tear through our upper atmosphere so noisily and brilliantly as to make first-page news all over the country. The Seattle fireball of about 12:30 a.m. PST, May 11, 1952, was decidedly one of these rare events. The writer has investigated it, as Pacific regional director of the American Meteor Society, and therefore is moved to report it in this department.

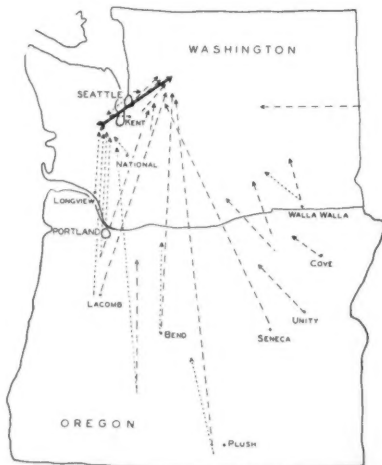
We have often heard that one who "hitches his wagon to a star" will attain success. The tail of a meteor would be good for a mere publicity seeker. After daylight on May 11th, various news agencies telephoned me at my home in Eugene, Ore. I remarked to one, "That sounds like a red-hot meteor to me," and this statement was quoted on front pages all over the country. I might have composed a more scholarly sentence had I been given time.

This spectacular fireball had the residents of Seattle really puzzled. Many were badly frightened. The burst alerted the Air Force and the Coast Guard.

It usually takes about a month for me to work up a fireball. During the interval between the appearance of this one and my report, a few people from various states wrote to me asking why all mention of the event had been "hushed up."

Tracing the Path

The first step in this work is to re-



The approximate path of the fireball is indicated by the heavy arrow, its beginning point shown by the convergence of the dotted lines, its end point by the dashed lines. Aviators 30 miles north of Missoula, Mont., saw the meteor due west. Diagram by J. Hugh Pruett.

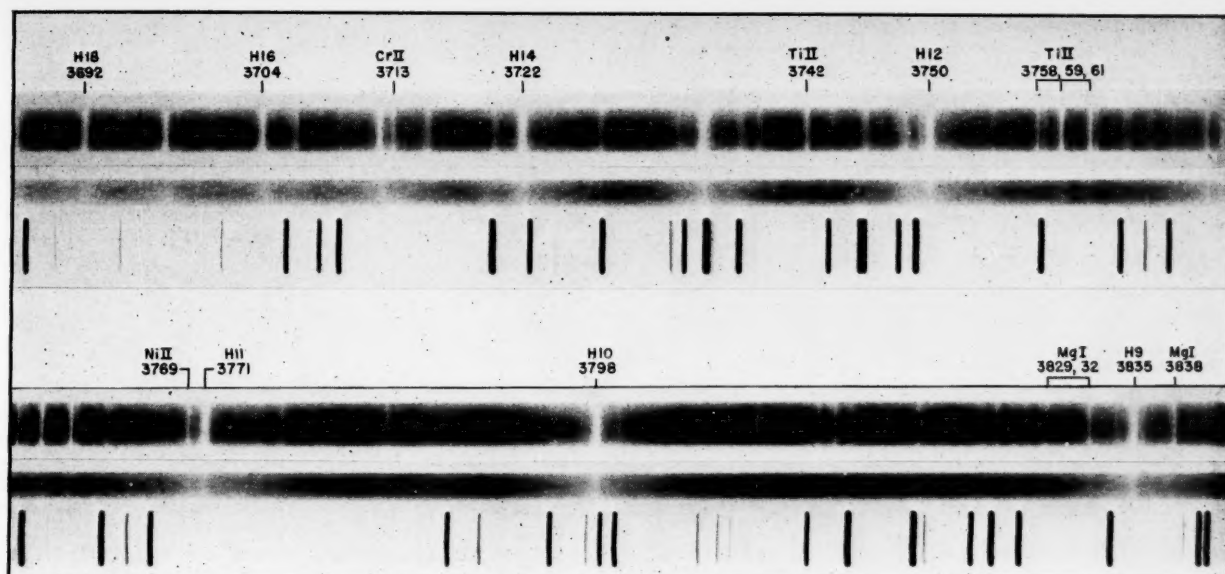
quest the larger newspapers to ask observers to send reports to me. The press has always co-operated splendidly. On the twilight meteor over California and Nevada in November, 1945, I received exactly 517 reports, whereas from 100 to 200 is the usual number. But the late hour of appearance of the Seattle meteor, combined with general cloudiness over northwestern Washington, resulted in my receiving only 66 reports. Some of the most helpful came from distant observers where the sky was clear.

The final results are shown by the accompanying map of Washington and Oregon. For the height of the beginning point only estimates were available, and these were so varied that no confidence can be accorded them. But the locality over which the fireball first appeared seems most likely to have been some distance west of Tacoma. It traveled in a northeasterly direction directly over Seattle.

The "blowup" locality was quite well established as approximately 50 miles northeast of Seattle at a height of about 20 miles. Even through clouds the final flareup seemed quite well localized in the sky. Two very fine instrumental measures on this point came from Sidney Howick, of the Seattle Weather Bureau, who at once used his theodolite, and Don Lyman, a Seattle civil engineer, who furnished very trustworthy altitude and azimuth.

Many of the observers stated that the object finally broke into many pieces which continued to glow individually for a moment. This leads me to believe that the meteorite was of the stony type, possibly the rare howardite. Metallic meteorites do not tend to so disintegrate. Dr. H. H. Nininger has found pieces of the Pasamonte, N. M., howardite of March 24, 1933, over a long line reaching back 30 or 40 miles before the end point. This leads to the prediction that remnants of this recent fireball may be found from a little northeast of Seattle to several miles beyond the breakup locality.

The "bang" of the shock wave produced by the meteor comes from the part of its path nearest the observer. This is often followed by guttural sounds from more distant parts of the path, both ahead of and behind the nearest point. Several observers in Seattle, where the ground path was across the southern part of the city, gave estimates of the interval between sight and sound. These ran from one to four minutes. Mr. Lyman said 2½ minutes. Since sound travels 12 miles a minute, this would place the nearest part of the path 30 miles from him, a reasonable height for the celestial missile as it passed over.



These spectra of Pleione, obtained by P. W. Merrill with the 100-inch Mount Wilson coude spectrograph, are reproduced in two parts, the top of shorter wave length, as labeled. The widest spectrum (upper part in each case) was made August 4, 1944, and shows numerous sharp absorption lines (bright on the negative) produced in the shell or ring of the star near the time of its greatest extent. The narrower spectrum (lower one) was taken February 24, 1951. Mount Wilson photo.

PLEIONE - A Story of Cosmic Evolution

BY OTTO STRUVE, *Leuschner Observatory, University of California*

DURING the past 15 years we have witnessed a tiny bit of stellar evolution in the making. Pleione is one of the less conspicuous of the naked-eye members of the Pleiades cluster. Located in the immediate vicinity of the much more brilliant star Atlas, it usually escapes the attention of the unaided eye. But even a small pair of opera glasses shows it as a bluish star of apparent magnitude slightly fainter than 5.

When the spectrum of Pleione was first photographed at Harvard Observatory, E. C. Pickering announced that it had not only the usual absorption lines of hydrogen and helium but also double emission lines of hydrogen, these flanking on both sides the absorption lines of the same element. But the emission lines grew fainter, and by 1905 E. B. Frost, at Yerkes Observatory, found no trace of them any longer. Yet the absorption lines were left unchanged; they were broad and diffuse and their appearance led astronomers to the conclusion that Pleione spins rapidly around its axis—about 100 times as fast as does the sun. Moreover, it seemed probable that the axis of rotation is oriented at right angles to the line of sight, which thus would be approximately in the plane of the star's equator.

At the same time it was concluded, mostly from work at Yerkes Observatory, that a rapidly rotating star like Pleione might easily become unstable at its equator. The sun, with its slow

equatorial rotation of two kilometers a second, is highly stable. The great centrifugal force of Pleione's rotation of some 200 kilometers a second not only might cause a large amount of flattening but might even aid other processes in driving off material at the equator. We should then expect to see the formation of a gaseous ring around the equator, in appearance not unlike the rings of Saturn.

Pleione is too far from us ever to permit the discovery of such a ring by direct telescopic observation. But indirectly the spectroscope can prove the existence of a ring, and can tell us its average radius, its density and temperature, and its motion.

The ring of Pleione (often referred to as a shell) appeared suddenly in 1938, when it was discovered by one of the two most indefatigable observers of peculiar stellar spectra, D. B. McLaughlin, of Michigan. (An independent and simultaneous discovery was announced by O. C. Mohler, then at the Cook Observatory near Philadelphia.) The ring remained visible (on spectrograms) until the beginning of 1952, when its disappearance was recorded by the other great observer of unusual stars, P. W. Merrill, at Mount Wilson. A discussion of the ring of Pleione by the latter has recently appeared in the *Astrophysical Journal*. Among his many important conclusions, we choose as the one of greatest general interest the manner in

which the ring finally disintegrated. A summary of what had happened is here quoted from Dr. Merrill's paper:

"After a long period of stability, some relatively minor circumstance caused a very slight but persistent acceleration of gaseous atoms outward from the photosphere and the normal reversing layer. The first result was the formation of an emitting gaseous envelope. When sufficient atoms had accumulated at higher levels, an absorbing shell was detected. At first, the outward motions were too small to be measured; in other words, the radial velocity of the shell was, within errors of observation, the same as that of the star as a whole. Gradually the acceleration increased, and the outward velocity of the upper levels became appreciable. For a while the spectrum showed only slow changes, as a nearly steady stream of atoms passed through the spectroscopically active zone. Eventually, however, the supply of atoms failed, and the shell blew away."

In this "blowing away" of the ring of Pleione we detect the action of a force that must play an important role in the evolution of a star. This force is probably related to what the physicists call radiation pressure.

We know that the ring of Pleione was never very dense. Between its origin in 1938 and about 1944, it became more and more conspicuous, showing stronger spectral lines, without changing much in density. Probably the thickness of the

layer grew rapidly while the density remained roughly the same. A density of 100 billion hydrogen atoms per cubic centimeter (far less than in the sun's reversing layer) and a total mass of about one 10-billionth of the mass of the star are probably correct as to the order of magnitude. If the shell blew away, then the star lost a small fraction of its mass; and if this process, though not a steady one, repeats itself fairly often, Pleione may be shedding its mass more rapidly than it can replenish it from the nebula which envelops the cluster.

It is tempting to explore the manner in which the pressure of radiation may aid a star in getting rid of a part of its mass. (The much more violent phenomena in expanding and exploding objects such as novae, Wolf-Rayet stars, P Cygni stars, and SS Cygni stars, are probably all related to this problem.) In order to understand how radiation pressure works in the gaseous medium that surrounded Pleione, it may be useful to consider related phenomena in the solar system.

We know from the observations of aurorae by Meinel at Yerkes, Gartlein at Cornell, and Vegard at Oslo, that hydrogen atoms reach the earth with high velocities (*Sky and Telescope*, September-October, 1951). These atoms are expelled by the magnetic forces associated with sunspots and other disturbances of the atmosphere of the sun. It is possible that not all hydrogen atoms expelled in this manner leave the sun permanently; many, perhaps most, fall back by gravity or by the attraction of other disturbed areas. But those that have succeeded in getting as far from the sun as one astronomical unit, or 150 million kilometers, with speeds radially outward of the order of 1,000 kilometers per second, cannot be brought to rest and cannot be made to fall back upon the sun by gravitation or by the sun's magnetism. They are expelled forever; and (with the exception of that insignificant fraction caught by the earth and by the rest of the planets) these atoms escape from our solar system and become a part of the gaseous substratum of the galaxy.

This does not necessarily prove that the sun's radiation pressure upon hydrogen atoms exceeds its force of gravitation. Perhaps the atoms are hurled out of sunspots with a velocity that so far exceeds the escape velocity, some 600 kilometers a second at the sun's surface, that they fly into space despite the retarding action of the sun's gravitation. There is no evidence that enormous speeds of thousands of kilometers per second are realized in the prominences of the sun. On the contrary, the existing data favor much smaller velocities, of the order of a few hundred kilometers per second at most. It would seem that the atoms are actually being accelerated while they are in flight.

There is another, indirect, piece of information that leads us to believe in the efficacy of radiation pressure in the solar system. Most recent theories of the origin of the planets start with a nebula whose composition was essentially similar to the present chemical composition of the sun: For every 1,000 atoms of hydrogen there were about 200 atoms of helium and two atoms of all the other chemical elements combined. Yet, the present composition of the planets—even the major ones—is much less hydrogen and helium, and much more iron and other heavy elements.

We know that the planets must have lost their light gaseous constituents through the process of molecular diffusion; one by one these atoms and molecules acquired large velocities as the result of successive collisions with other atoms and molecules. Those that exceeded the escape velocity of any given planet (about 11 kilometers per second for the earth), flew out into the solar system, where they were no longer appreciably retarded by the parent planet.

What has happened to this gaseous medium? In total it should have contained about 10 or even 100 times as much mass as all the planets contain at the present time. Such a medium would be easy to discover by spectroscopic means, if not by its dynamical effect upon the motions of the planets. It does not exist; the light gaseous atoms have either fallen upon the sun or they have been expelled by radiation pressure. There is no very good reason why they should have fallen upon the sun; to begin with they certainly shared the motions of the planets, and, barring the cancellation of these motions by frequent collisions among themselves, they would continue revolving around the sun as the particles of the rings of Saturn revolve around the planet without falling into it. It is more probable that the free atoms of hydrogen and helium have been expelled by radiation pressure.

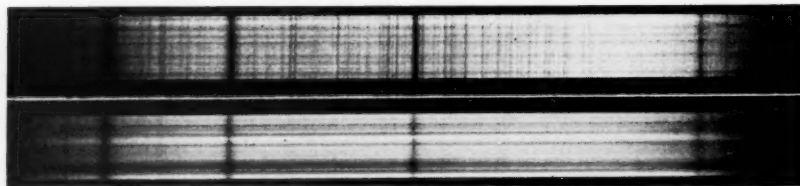
Although we do not actually see this expulsion of *hydrogen* and *helium*, we do see the process taking place in comet tails, where molecules containing hydrogen, such as CH^+ , are driven off, together with others that do not contain hydrogen but that, nevertheless, consist of fairly light elements, such as cyanogen

(CN). No one who has seen the tail of a brilliant comet—always directed away from the sun—can doubt for a moment that radiation pressure is enormously important in the whole dynamics of the solar system; it can only be neglected when we discuss the motions of large, solid bodies, like the planets.

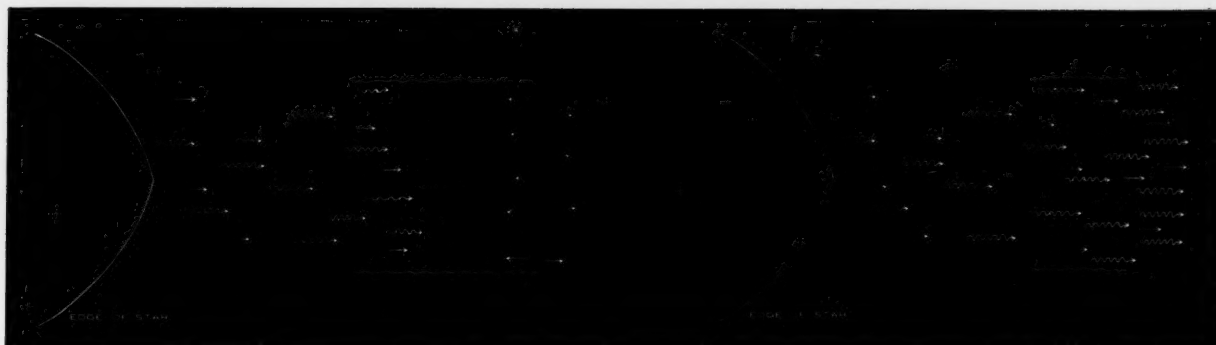
Yet, when we apply our theoretical knowledge of the sun's radiation to evaluate the amount of this expulsive force acting upon a single hydrogen atom outside the sun's atmosphere, we find that it constitutes only about one one-millionth of the sun's force of gravitation, an altogether insignificant fraction. Moreover, this fraction remains the same whether the atom is close to the sun or far away from it.

In order to reconcile the theory with the unmistakable data of observations, A. Unsöld proposed long ago that the sun may possess far more ultraviolet light (of wave length about 800 to 900 angstroms) than was previously thought consistent with the photosphere's surface temperature of less than 6,000° absolute. There are other reasons that had suggested a large ultraviolet excess in the invisible part of the sun's spectrum, including some terrestrial effects, such as the ionization of our upper atmosphere, the ionosphere. The rockets at White Sands will undoubtedly soon give us direct observational evidence of this excess, if it really exists. At sea level, and even at our highest mountain observatories, the oxygen and ozone in the air completely blot out all solar radiations at these short wave lengths. Some astronomers who have observed the stars will feel uncomfortable about any very large ultraviolet excess, such as is required by Unsöld's theory. For example, the entire foundation of the Zanstra-Menzel mechanism of determining the temperatures of stars surrounded by gaseous nebulae rests upon the assumption that in these hot stars the ultraviolet excess is negligible.

What small amount of information that has already been announced from the rocket flights at White Sands makes it also appear that, at least in the nearer ultraviolet region, the excess of radiation over that of a black body is not very large. It is therefore of interest that L. Biermann in Germany proposed a



W. W. Morgan, of Yerkes Observatory, made these low-dispersion spectrograms of Pleione. The Balmer lines are prominent in both, but the upper spectrum (August 12, 1947) shows the numerous lines produced by the shell or ring around the star; in the lower (December 18, 1950), these have virtually disappeared. Yerkes Observatory photograph.



This is a schematic representation of the manner in which the star may first retain its shell, then lose it. At the left the shell is thick enough to prevent penetration of light quanta (wiggles), and relatively few atoms escape from the outside of the shell. If the supply of atoms maintaining the ring lessens, it may slowly become thinner, and quanta penetrating clear through it will drive off corpuscles against the star's gravity, as shown at the right.

year or so ago that in the total radiation pressure we must count not only collisions with light quanta but also the collisions with particles—protons, electrons, and the like—that are constantly projected outward from the sun's surface.* Therefore, when we speak of radiation pressure we include in this term radiation of light quanta and also corpuscular radiation of an unknown amount. Despite the absence of a final test by means of rockets, we are reasonably certain that radiation pressure does propel many atoms and small grains of dust away from the sun. Yet the solar atmosphere does not expand as a whole, as does the atmosphere of a star like P Cygni. Nor is there any large expansion evident in the solar corona. It is clear that we must use caution when we speak of radiation pressure. Certainly the highly ionized atoms of elements, like Fe XIV, in the corona, are not very sensitive to the pressure of the sun's radiation in those frequencies where the sun, with its relatively cool outer temperature, possesses any appreciable amount of radiation, and this remains true even though the ultraviolet excess predicted by Unsöld may be very large, percentagewise. But even in the solar chromosphere, where ordinary hydrogen and helium spectral lines are produced, there is no general tendency among the atoms to fly off into space.

This is a contradiction that has baffled some of the most experienced astronomers. On the one hand, we say that we possess incontrovertible evidence that radiation pressure upon hydrogen atoms has a large preponderance over gravitation. We even maintain that this preponderance results in expanding the chromosphere above its theoretically calculated elevation—a phenomenon that becomes exceedingly conspicuous in many stars other than the sun (Cepheids, supergiants). Yet, on the other hand, we fail to observe the escape of the atoms

from undisturbed solar regions, and we are more than willing to concede that forces other than radiation pressure (such as magnetism) may be activating those atoms that produce violent Doppler shifts in solar flares and the like.

This difficulty can be resolved when we realize that in the solar reversing layer and the chromosphere no single atom has a chance of escaping without first colliding with another atom and being deflected by it. Hence, the end result of a great many such collisions, acting in a general way outward from the sun, will be to *blow up* the gas. Only at the extreme outer edge, where the chances of collision are exceedingly small, will an atom be *blown off*—and even then only so long as it is not fully ionized, for as a proton or an alpha particle it is no longer capable of absorbing the quantum of energy that serves to propel it. Of course, it is then still activated outward by the process of radiation scattering, which affects mostly the free electrons, and by the pressure of corpuscular radiation. But electrons are so much lighter in weight than the protons and alpha particles that they would be incapable of dragging their heavy partners away from the sun. Despite their temporary divorce, the electrons cannot get very far away from these partners, for the electrical forces between them compel them to remain together in space, even though they are no longer tied together in the form of neutral atoms.

Thus, in the case of the solar system, the question arises: How long will an atom of hydrogen remain neutral and how fast will it be propelled by radiation pressure before it becomes permanently ionized? The answer is found in the theory of ionization, but we shall not pursue this line of reasoning further because it does not apply directly in the case of Pleione. In the spectrum of Pleione, during the shell stage of 1938-1952, the lines of hydrogen were strong and sharp. Neutral hydrogen was therefore quite abundant, and the ques-

tion of its ionization is not an important one. We might estimate that, on the average, the ring contained about one-half neutral hydrogen and one-half ionized hydrogen (protons and free electrons). Consequently, if the neutral hydrogen was propelled outward, it must have dragged the other half with it, together, of course, with the very small admixture of other chemical elements not so sensitive to radiation pressure.

Merrill's conclusion that the shell blew away when its density, or rather its thickness, had become greatly reduced, finds an explanation in precisely the same reasoning which explained the fact that the sun's chromosphere does not normally blow away (only its outermost atoms do).

If, for some reason, a ring has been formed, containing a large number of hydrogen atoms along a radius drawn from the center of the star, then the innermost atoms are exposed to the impinging quanta and corpuscles of the star's radiation but cannot escape because they will first collide with higher-lying atoms. The latter, on the contrary, are shielded from the powerful quanta and particles so long as there are enough atoms in the shell below them. Their weight, like that of a heavy blanket, prevents the entire ring from expanding.

It is only after the supply of atoms from below has ceased that at first some few outer atoms succeed in escaping, thereby reducing the *optical thickness* of the layer. Finally, it becomes like a sieve that transmits most of the star's ultraviolet quanta and its corpuscles into the uppermost strata. It is then that the remaining gas blows off.

This picture is not yet complete. We do not know what it is that allows the ring to form in the first place. As far as we can tell, the star's own radiation does not undergo any *measurable* changes. But perhaps there are minor changes, too small to be observed, yet large enough to destroy the delicate balance between

(Continued on page 254)

*I owe some illuminating comments on this problem to G. P. Kuiper, of the Yerkes Observatory.

GALILEO'S VISITS TO ROME - II

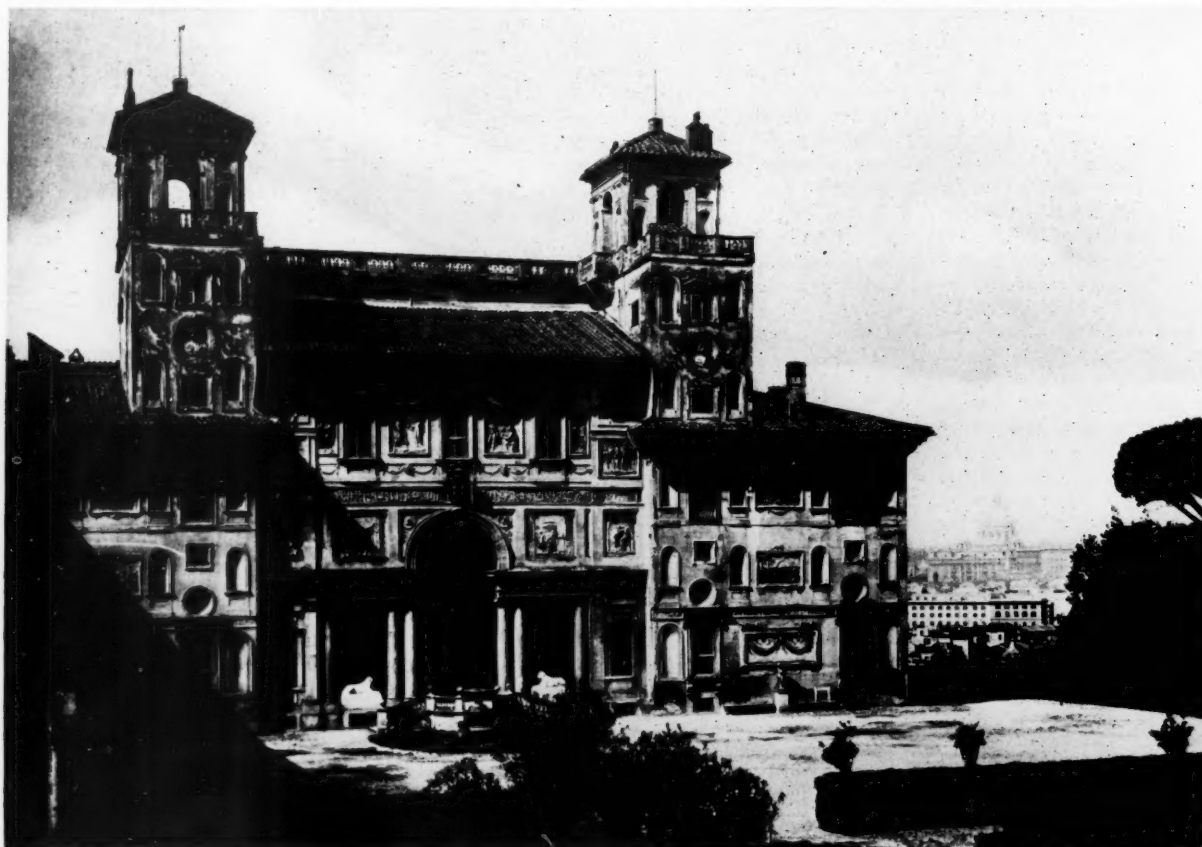
BY WALTER J. MILLER, S.J., *Vatican Observatory*

SINCE GALILEO would not yield to Bellarmine's persuasion, the Dominican Father Michelangelo Segizzi, commissary of the Holy Office, at once imparted the solemn admonition to Galileo in the apartments of Cardinal Bellarmine on February 26, 1616; and Galileo promised to obey. Due to this submission, the subsequent decree of the Congregation of the Index, dated March 3, 1616, spared Galileo from any public prohibition of his books, although it did prohibit Copernicus' book *De Revolutionibus Orbium Coelestium* until a few verbal corrections were made to show that the Copernican doctrine was taught only as a hypothesis for explaining the observed facts of astronomy. On March 11th Galileo had a most cordial, three-quarter of an hour audience with Paul V, to whom he confessed his fear of being thereafter continually persecuted by his calumniators. The Pope answered that both he and the Congregation had the highest opinion

of his integrity of life and sincerity of mind, and neither would easily believe any such calumnies against him. Paul V assured him repeatedly that, as long as he would be Pope, Galileo would be safe and even favored on every possible occasion.

Quite definitely the Congregations of the Holy Office and the Index were in error. Even though the consultors could rightly disagree with those who believed that Galileo's observations had already proved the heliocentric hypothesis to be a fact, still these same consultors had been amply warned of the possibility that the theory might later be proved a fact after all. They had closely examined Galileo's irreproachable reconciliation of the Scripture texts with his observations. They knew that he cited the authority of St. Augustine, St. Jerome, St. Thomas Aquinas, and others who taught that the Bible does not aim to instruct us on the nature of the phenomena but limits itself to de-

scribing the appearances of things and for this purpose uses the terms in current usage. Legitimately, the Congregations could have issued a strictly disciplinary decree forbidding Galileo to teach or even to hold the Copernican doctrine as a proved fact. But when the consultors and the Congregations and even the presiding Pope concurred in stigmatizing the doctrine as anti-scriptural and heretical, they made a lamentable mistake which with due care and caution they could have avoided on the basis of the evidence they already had in their possession. Though the implicit condemnation of Copernicanism as heretical in no way concerns papal infallibility (since Catholic doctrine attributes that prerogative only to the Pope's solemn *ex cathedra* decisions and not to the decrees of Congregations), still the blunder was a grave one. Human prejudices and human passions may partially explain but they cannot excuse this, the crucial error in the



The Villa Medici was Galileo's abode during a number of his visits to Rome. From this garden in 1616 he observed the moons of Jupiter with his telescope. The villa was built in 1544, and the design of the interior facade shown here was suggested to the architect, Annibale Lippi, by Michelangelo. Napoleon purchased the building in 1801. Since 1803 it has been the Académie Française, where young French artists who have won the Prix de Rome come to live and study during their three-year scholarship. The dome of St. Peter's may be seen off to the right.

conceded to this theory but only hypothetical truth, that is, apart from the Scriptures. Also it must be shown that this work is written only to show that all the reasons are known which can be brought forward to support this theory, and that the theory banned in Rome has not been banned for lack of knowing those reasons.

The printing of the *Dialogues* was finally finished on February 21, 1632, and at once a great furor ensued. This was partly due to personal complications. In 1624, Urban VIII himself had given Galileo a metaphysical argument which the Pope believed was an unanswerable proof of the falsity of the Copernican theory. At that time the Pope insisted on having this argument included in Galileo's contemplated book on the heliocentric and geocentric hypotheses. The two intelligent persons in the *Dialogues* are Salviati, a thinly veiled model of Galileo arguing skillfully for Copernicus, and Sagredo, the equivalent of Mr. Common Sense. The third person is Simplicio, the foolish simpleton who represents the Aristotelian philosophers, and whose naive and faulty reasoning in favor of the Ptolemaic views is so facetiously refuted that he soon becomes a laughingstock for the intelligent reader. Unfortunately, Galileo put the Pope's own argument in the mouth of Simplicio, without other comment than to have Salviati say, "A wonderful and truly angelic doctrine!" Galileo was certainly not foolish enough to wish to make fun of the Pope in a book whose very publication depended on having the papal imprimatur. But the imprudence furnished Galileo's many enemies with an opportunity that they gleefully utilized to the full, by trying to poison the mind of Urban VIII against Galileo.

However, too much importance should not be ascribed to the incident of Simplicio. We have the Pope's own repeated assurances both that he believed Galileo never intended ridiculing him, and that the Pope's chief concern was the "very serious danger for all of Christendom." Urban VIII held that it was no longer a question of a mathematical theory but rather of impugning the veracity of Sacred Scripture. The Pope was much displeased when he found out that Galileo had patently flouted the 1616 decree forbidding him to teach Copernicanism, which had been declared by competent ecclesiastical authority to be contrary to the Sacred Scriptures. Contempt for the Church's authority in that day and age was not to be tolerated even in his friend.

The Pope at once set up a special commission to make a full investigation both of the book and its doctrines and of the manner in which the imprimatur had been obtained without his knowledge. On April 17, 1633, after a month's work, the commission handed

in its report, complete with detailed proofs of a fact nobody could deny, that Galileo had taught Copernicanism as a fact in flagrant disobedience of the 1616 prohibition. In spite of the intercession of Galileo's patron, the grand duke of Tuscany, and of other influential personages, Urban VIII inflexibly insisted that the question be turned over to the Roman Inquisition for the routine process of that ecclesiastical court. Meanwhile, Galileo had been summoned peremptorily to Rome, where he arrived finally on February 13, 1633, on his sixth (and saddest) visit, which ended with Galileo in disgrace and a nominal prisoner of the Holy Office for the remaining nine years of his life.

The proceedings of the Inquisition in 1633 were not concerned with the truth or falsity of the heliocentric hypothesis, but only with the disciplinary question of Galileo's disobedience. Galileo was personally examined by the commissary of the Inquisition on April 12, April 30, and May 10, 1633. On June 16th Urban VIII presided over the decisive plenary meeting of the Holy Office, in the Quirinal Palace (now the official home of the president of Italy, as it was the home of Italy's kings since 1873). The Pope gave orders that Galileo was to recant before a full session of the Holy Office, was to be condemned to prison at the discretion of the same Congregation, and was to be forbidden thenceforth to discuss in writing or in speaking either the Ptolemaic or the Copernican hypothesis.

Accordingly, on June 21st Galileo was summoned once more before the Inquisition, and in response to a question three times repeated, he abjectly affirmed under oath: "I do not hold and have not held this opinion of Copernicus since the command was given me that I must abandon it." On June 22nd the solemn ceremony of the condemnation of Galileo and his public abjuration took place in the Aula Grande or Great Hall of the Inquisition. The sentence was first read to him, and then Galileo on his knees read the prescribed abjuration and signed the document. The apocryphal story (first appearing in print only in 1761) that Galileo in rising from his knees muttered to himself the words, "Eppur si muove" ("And yet it does move"), seems to be only an interesting fable. The documents of the 1633 process and those from 1616 as well are still preserved in the archives of the Vatican library, and have been published in full in Vol. XIX of the *Edizione Nazionale*.

During 15 of the 20 weeks of Galileo's last sojourn in Rome, he lodged with his close friend, Francesco Niccolini (now Tuscan ambassador, as his father Giovanni was before him), in Palazzo Firenze. After the abjuration, Galileo's last days in Rome were spent

in custody at Villa Medici, from June 24 until July 6, 1633, the day of his final departure from Rome. About three weeks were spent (April 12-30 and June 21-24) in light confinement in rooms normally occupied by the Inquisition officials on the second floor of the Convent of Santa Maria sopra Minerva.

In 1873, more than half of the Dominican Convent was appropriated by the Italian Government (as was also the nearby Roman College of the Jesuits, which was likewise closely associated with Galileo), and the 1927 Lateran Pact settlement of the Roman question legalized these and other seizures. Since a Dominican house of studies still remains in the unappropriated part next to the church, and since the cloister garden (where Galileo was permitted to walk) gives the only open view of the rooms on the second floor where Galileo was a prisoner of the Inquisition, it is worthwhile asking the porter at No. 42 Piazza della Minerva (illustrated on page 213 last month) for permission to enter. One of the Dominican fathers will point out where the really severe underground prisons of the Inquisition used to be, and also the narrow stairs by which the cardinals were wont to go up from the cloister portico to the second-floor Great Hall where the plenary meetings of the Holy Office were held. The wing on that side of the cloister is the property of the Italian ministry of posts and telegraphs.

This same government ministry has maintained the Aula Grande, scene of Galileo's abjuration, in excellent condition. This hall on the second floor is now used as the minister's private library, and the lamps on the long central table even have lampshades bearing the words, "Eppur si muove." (Permission to visit this interesting scientific shrine may be readily obtained from the *Ufficio Informazioni* at the main entrance, No. 76 Via del Seminario.) A few minutes spent in this dimly lighted and solemn room bring the reverent pilgrim in spirit to the culminating moment of the tragedy of Galileo.

LUNAR ATMOSPHERE

The latest determination of a lunar atmosphere comes from France from Audouin Dollfus, who worked with the advice of the late Bernard Lyot. Using the Pic du Midi coronagraph and a polarimeter, Dollfus found that the bottom of the lunar atmosphere has a density less than a thousand-millionth of the terrestrial atmosphere. This limit is 10 times less dense than had been obtained from photometric measurements in 1949. It is, however, possible that local or transitory values may be somewhat higher.

NEWS NOTES

BY DORRIT HOFFLEIT

SIX THOUSAND TONS PER DAY

Dr. Frederick C. Leonard, University of California at Los Angeles, estimates that the amount of meteoritic material, including the ashes of burned-out meteorites and the unburned micrometeorites, that falls on the earth each day is 6,000 metric tons. Earlier estimates have been very small compared to this, of the order of one metric ton per day.

According to Dr. Leonard, since there are some 200 million square miles on the earth's surface, the meteoritic dust collected on each square foot amounts to only one millionth of a gram per day, which is the same as a gram per square foot every 3,000 years. Were this accretion to continue at this rate long enough, the mass of the earth would be doubled in three quadrillion years, but this is a million times longer than the present estimated age of the earth, three billion years.

120-INCH DOME COMPLETED

In March the building for the Lick Observatory 120-inch telescope was completed. It is described in an illustrated account by W. W. Baustian in the *Publications* of the Astronomical Society of the Pacific for June, 1952.

The dome can be rotated once in five minutes, while the up-and-over main shutter has a fast motion of 20 feet per minute, and a slow motion of 2.5 feet per minute. The prime-focus elevator moves at 30 feet per minute. It is uniquely mounted across the shutter opening. Insulating panels on the inner surface of the dome have an embossed pattern of 1-inch squares which helps soundproof noises originating within the dome.

The building contains four offices, a visitor's gallery, staff rooms, the optical shop, space for an electronics laboratory, a coude room at the south end of the polar axis, three air-conditioned windowless bedrooms, darkrooms, and storerooms.

Installation of the grinding equipment for the mirror has been in progress in the optical shop, and work on the mirror itself was scheduled to begin this summer. The figuring of the large and auxiliary mirrors will be under the supervision of Don Hendrix, superintendent of the optical shop of the Mount Wilson and Palomar Observatories.

Meanwhile, the University of California has announced that contracts for the mounting have been awarded to the Judson Pacific-Murphy Corporation, Emeryville, Calif., for \$938,483. The two-pronged steel fork will weigh 85 tons, carrying a 35-ton steel tube hold-

ing the mirror. With this type of mounting, the whole sky will be accessible except for a strip close to the horizon.

Dr. C. D. Shane, director of Lick Observatory, estimates that both the mirror and the mounting will be completed at about the same time, exploration of the heavens with the 120-inch to begin in two or three years.

ANNEALING TEMPERATURES

Recent experiments at the National Bureau of Standards have shown that annealing temperatures of optical glass can vary over a wide range without decreasing the very high refractive homogeneity obtainable. The results reported by L. W. Tilton, F. W. Rosberry, and Florence Badger suggest a great possible saving in time and materials in the future manufacture of optical glass.

As glass passes from the liquid to the solid vitreous state, strains are set up which seriously affect both its mechanical and optical properties. Annealing, or heating to a temperature just short of the softening point, holding at a somewhat lower temperature, and cooling gradually, releases the strains and, when properly carried out, gives optical glass of uniform refractive index. The refractive index is affected by both temperature and composition. Heretofore it has been felt that the required uniformity in refractive index could not be obtained except at maximum density, which, in turn, requires the lowest feasible holding temperature. This meant that undue consideration had to be given to the composition of the glass for any desired index of refraction. The

IN THE CURRENT JOURNALS

MOLECULES OF GAS AND GRAINS OF DUST IN INTERSTELLAR SPACE, by C. S. Beals, *Journal*, Royal Astronomical Society of Canada, March-April, 1952. "Most astronomers now believe that the total mass of interstellar matter is greater than that of the stars and that the process of the condensation of stars may still be going on."

LIFE AND ITS EVOLUTION FROM AN ASTRONOMICAL VIEWPOINT, by E. J. Opik, *Irish Astronomical Journal*, March, 1952. "Thus, the present pageant of life on the surface of our planet is the first, the only, and the last chance, without any prospect of repetition."

THE SOUTHERN SKY, by Bart J. Bok, *Scientific American*, July, 1952. An account of photographic investigations with the new Schmidt telescope in South Africa.

work carried out at the Bureau of Standards, however, shows that optical glass of high quality for precision optical instruments can be obtained from annealings in which the holding temperature is 30 or 40 degrees centigrade above the lowest feasible annealing temperature.

LUNAR OBSERVERS, ATTENTION

Only from time to time does one hear speculation on the possibilities for observing meteors or meteoritic impacts on the moon. Since observations of lunar meteors are at best uncertain, it is very important that suspected objects be seen simultaneously from at least two stations. In the current issue of the *Strolling Astronomer*, a list is given of 10 possible lunar meteors observed by Lyle T. Johnson at La Plata, Md., with a 10-inch reflector. His observations represent 19 hours at the telescope on 18 different dates in 1951. Six of the 10 objects were reported as "flashes," the others as moving specks, two of them having projected path lengths of about 80 and 110 miles. Observations such as these but made in duplicate are extremely important for solving the mysteries of a possible lunar atmosphere, as well as for ascertaining the frequencies of extremely large meteoritic bodies.

ASTRONOMERS TO SPEAK BEFORE OPTICAL SOCIETY

The annual meeting of the Optical Society of America will be held at the Hotel Statler, Boston, Mass., on October 9, 10, and 11, 1952. An address will be given by the 1952 Ives medalist, Dr. Ira S. Bowen, director of Mount Wilson and Palomar Observatories. Following the dinner Friday evening, Dr. Harlow Shapley, of Harvard Observatory, will speak on the contributions of optical instrumentation to astronomy.

The meeting will be open to non-members of the society, and all interested persons are invited to attend. Copies of the program may be procured from Dr. Arthur C. Hardy, secretary, Optical Society of America, Massachusetts Institute of Technology, Cambridge 39, Mass.

THE AEROPAUSE

Science Service reports a suggestion by Drs. Konrad Buettner and Heinz Haber, of the University of California at Los Angeles, that the region of the air heretofore vaguely referred to as the upper atmosphere be called the aeropause. It is to be defined as the portion between approximately 12½ and 125 miles altitude, where conventional airplanes cannot fly but where from other standpoints the conditions of outer space have not been reached.

Amateur Astronomers

ACTIVITIES AT THE NORTHEAST REGIONAL CONVENTION

A MOVIE of Chubb Crater, with commentary by Dr. V. Ben Meen, director of the Royal Ontario Museum of Geology and Mineralogy, Toronto, who brought the attention of astronomers to its meteoritic origin, highlighted the Northeast regional convention. About 75 league members attended the meetings at Buffalo and Rochester on the weekend of May 30-June 1. Dr. Meen's talk was entitled, "Solving the Riddle of Chubb Crater."

The convention opened at the Rochester Museum of Arts and Sciences with a session for reports from the 17 regional societies. Ralph K. Dakin, of Rochester, described filters for observations in daylight; Dr. Henry E. Paul, Norwich, N. Y., described and demonstrated his birefringent monochromator for solar prominence observing; and Paul W. Stevens, regional chairman, showed Kodachrome slides of 1951 solar eclipses and a short motion picture of the February, 1952, lunar eclipse.

In the evening, the delegates were welcomed by curator Beaumont Newhall to Eastman House, former home of the late George Eastman, and now a museum of photography, where they examined an exhibit of astronomical photographs. Almost 200 of the Rochester public, in addition to conventionites, attended Dr. Meen's lecture, afterwards taking advantage of clear skies to observe through eight instruments set up in the Eastman Garden by members of the Rochester society.

A tour of Eastman House on Satur-

day morning was followed in the afternoon by a trip to Niagara Falls. Between the Whirlpool State Park and Buffalo, the delegates visited the private observatory of Walter Semerau. The banquet at the Buffalo Trap and Field Club included short talks by Dr. F. Shirley Jones and Robert Hermes, who was photographer on the 1950 expedition to Chubb Crater. Afterwards, a visit was paid to the Buffalo Museum of Science, which has a Spitz planetarium in regular operation. An illustrated lecture on space travel was given by Kurt Stehling, Bell Aircraft Corporation. The Kellogg Observatory was used for observing that evening, before the return trip to Rochester.

The concluding business session was held Sunday morning, at Cutler Union on the University of Rochester campus. There was an open forum on observing programs, in which Claude H. Smith, regional director of the American Meteor Society, told how to observe and report a fireball. Dr. Carl W. Gartlein, Cornell University, described a new graphic report for auroral observations. Clarence Johnson, of Schenectady, junior activities chairman of the league, presented an "Introduction to Junior Astronomy."

Officers of the Northeast region were elected as follows: chairman, Mr. Johnson, Schenectady; vice-chairman, Edward Lindberg, Buffalo; secretary, Edwin M. Root, Rochester; treasurer, Mrs. Helen Velardi, New Haven.

Among those attending the conven-



Members of the Astronomical League attending

tion were G. R. Wright, president of the Astronomical League; Grace C. Scholz, executive secretary; and Mabel Sterns, editor of the *Astronomical League Bulletin*.

KEY TO GROUP PHOTOGRAPH

The numbers apply from left to right. The letters stand for the metropolitan areas of the following cities: B, Boston, Mass.; NH, New Haven, Conn.; NY, New York, N. Y.; P, Portland, Me.; R, Rochester, N. Y.; S, Springfield, Mass.; W, Washington, D. C.

1, Mrs. C. Cook, B; 2, W. Hollingsworth, R; 3, Elizabeth Fazekas, W; 4, C. Cook, B; 5, Grace Scholz, W; 6, R. Gagan, B; 7, J. Gagan, B; 8, E. Rademacher, NH; 9, G. Milne, R; 10, Mrs. E. Rademacher, NH.

11, J. Welch, S; 12, Mrs. J. Welch, S; 13, E. White, R; 14, Mrs. E. White, R; 15, M. Ream, R; 16, F. Velardi, NH; 17, Una Wheeler, R; 18, L. Magruder, R; 19, Lillian Budd, NH; 20, Sara Furnald, NH.

21, Mrs. F. Velardi, NH; 22, Florence Welter, NH; 23, V. Ben Meen, Toronto, Ont.; 24, M. Calkins, R; 25, G. Walker, Buffalo, N. Y.; 26, Mrs. P. Stevens, R; 27, Lillian Goetz, Schenectady, N. Y.; 28, C. Field, R; 29, J. Patterson, B; 30, M. Groff, R.

31, P. Stevens, R; 32, C. Daniels, P; 33, Mrs. C. Daniels, P; 34, Louise Zeitler, R; 35, Mabel Sterns, W; 36, R. Mallett, NY; 37, E. Oravec, NY; 38, Mrs. R. Mallett, NY; 39, K. Weitzenhoffer, NY; 40, Mrs. C. Foster, R.



Left: Dr. V. Ben Meen described his explorations of the crater in Ungava, Canada, from the platform in the Dryden Theater. Right: Dr. Henry Paul demonstrated his birefringent polarizing monochromator and displayed a sample of the optical quartz required in its construction. Photographs by Bill Hollingsworth.



People attending the Northeast convention gathered near a sundial in Eastman House gardens for this photograph by Bill Hollingsworth.

41, E. Epstein, NY; 42, Mrs. R. Dakin, R; 43, E. Root, R; 44, H. Paul, Norwich, N. Y.; 45, J. Johnson, R; 46, Mrs. J. Johnson, R; 47, Ralph Wright, Worcester, Mass.; 48, Mrs. J. Smith, R; 49, B. Cleveland, Elmira, N. Y.; 50, J. Smith, R.

51, R. Dakin, R; 52, C. Foster, R; 53, Irene Warthen, W; 54, G. R. Wright, W; 55, S. Weber, R; 56, Mrs. G. R. Wright, W.

MIDDLE EAST CONVENTION

Detroit will be the focal point of Middle East amateurs on September 5-6 for the regional Astronomical League convention. The Pontiac-Northwest Detroit Astronomers Association and the Detroit Astronomical Society will be the hosts, with the Wayne University science building as the site of meetings and exhibits.

In the vicinity is the Cranbrook Institute of Science, site of the national convention in 1947. The societies' state fair exhibition, where thousands last year first looked through a telescope, can be seen in operation at the Michigan State Fair.

Meetings will include papers from the members of the region, a junior session, and lectures by several professional astronomers. Tours will be arranged to Ford's Greenfield Village and the Edison Museum in Dearborn.

Rooms may be reserved at the student center at Wayne University at \$1.50-\$2.00 per person. Mrs. Mabel Chircop, 163 Prospect St., Pontiac, has charge of reservations. Those wishing to present papers should write the undersigned.

MRS. OLIVE GRUNOW
26520 W. Chicago
Detroit 28, Mich.

THIS MONTH'S MEETINGS

Dallas, Tex.: Texas Astronomical Society. August 25, 8 p.m., field meet, home of Mr. and Mrs. Ralph Ingraham, 2720 Poinsetta Dr.

Indianapolis, Ind.: Indiana Astronomical Society. August 3, 8 p.m., observation meeting, Butler University. J. E. Tambllyn, "Meteors."

Los Angeles, Calif.: Los Angeles Astronomical Society, 7:45 p.m., Griffith Observatory. Paul Roques, Griffith Observatory, "Eclipsing Binaries."

Miami Springs, Fla.: Gulfstream Astronomical Association, 8 p.m., intra-mural armory, main campus, University of Miami. August 22, Norman S. Bean, technical adviser, WTVJ, "Simple Lenses and Their Use in Television, Photography and Astronomy."

NORTH CENTRAL REGION

FORTY-ONE MEMBERS of the North Central region met June 7th at the Milwaukee County Historical Exhibits Building for the sixth annual regional convention. Dr. C. C. Wylie, of the State University of Iowa, gave the principal address; he spoke about meteors in space, their entry into the earth's atmosphere and their recovery as meteorites and meteoritic dust. He discussed many of the recent spectacular meteors, including the great fireball of July 22, 1949.

Five talks were presented by members of the region in the morning session, including a paper by Dr. Albert Schatzel and one by W. M. Lorenz, both of the Adler Planetarium in Chicago. William B. Albrecht, president of the Mil-

waukee Astronomical Society, discussed auroras; and Ralph Buckstaff, of Oshkosh, Wis., reported on solar activity in 1952.

Dr. Harvey Pettit, of Marquette University, highlighted the banquet with a speech on "Curiosity." Practically the entire party drove to the Milwaukee Astronomical Society observatory following the dinner. Delegates took advantage of an almost perfect sky to observe Mars and Saturn with the society's telescopes.

New officers elected at the business meeting were Joseph Anderer, Chicago, chairman; Dr. Schatzel, Chicago, vice-chairman; Charles Sturtzen, Milwaukee, secretary-treasurer; and Roy Dodd, Milwaukee, regional councillor.

CHARLES STURTZEN
Milwaukee Astronomical Society

WESTERN CONVENTION PROGRAM

The opening of the fourth annual convention of western amateurs on Monday morning, August 18th, at the Leuschner Observatory of the University of California, will include a business session and an address by Dr. Otto Struve, director of the observatory, on "The Amateur's Place in Astronomy." The afternoon session will be devoted to papers. On Monday evening, the annual dinner will be held at the Claremont Hotel (\$3.65 per person, including tax and tip), followed by a star party.

Tuesday, there are scheduled the presentation of papers, viewing of exhibits, and probably some tours. On Wednesday, following a session for papers, visitors will leave for Lick Observatory, on Mt. Hamilton. This trip is strictly limited to those registered for the convention, and children under 14 may not participate.

The convention registration fee is \$2.00 per person. New dormitories on the campus are available, but not for children under 14, the maximum cost to be \$3.00 per night per person. Advance notice for reservations should be given, stating whether they are for a man, or woman, or a married couple, and for which nights. Meals will be available at campus cafeterias.

Special tours are scheduled to the University of California cyclotron on Sunday afternoon, August 17th, preceding the convention opening, and other tours may be made to the California Academy of Sci-

ences, private observatories in Eastbay, and to the physics, chemistry, mining, engineering, geology, and other departments of the university.

Checks for registration should be made payable to the Eastbay Astronomical Society, and all communications should be addressed to the undersigned, secretary of the convention committee.

MISS H. E. NEALL
1626 Chestnut St.
Berkeley 2, Calif.

MID-STATES CONVENTION

The Mid-States region of the Astronomical League will convene on September 5th to 7th in St. Louis, Mo., when the St. Louis Amateur Astronomical Society and the Astronomical Society of Emerson Electric Company will act as co-hosts. Meetings will be held at the Emerson Electric Company auditorium, park, and observatory, and at the St. Louis University Institute of Technology.

RECENT ISSUES WANTED

Unprecedented demand has exhausted the February and April, 1952, printings of *Sky and Telescope*, and the May issue is in short supply. We shall be pleased to refund 40 cents for each copy of these issues that is returned to us in good condition. Please wrap them carefully, as otherwise they may not be acceptable for re-use.

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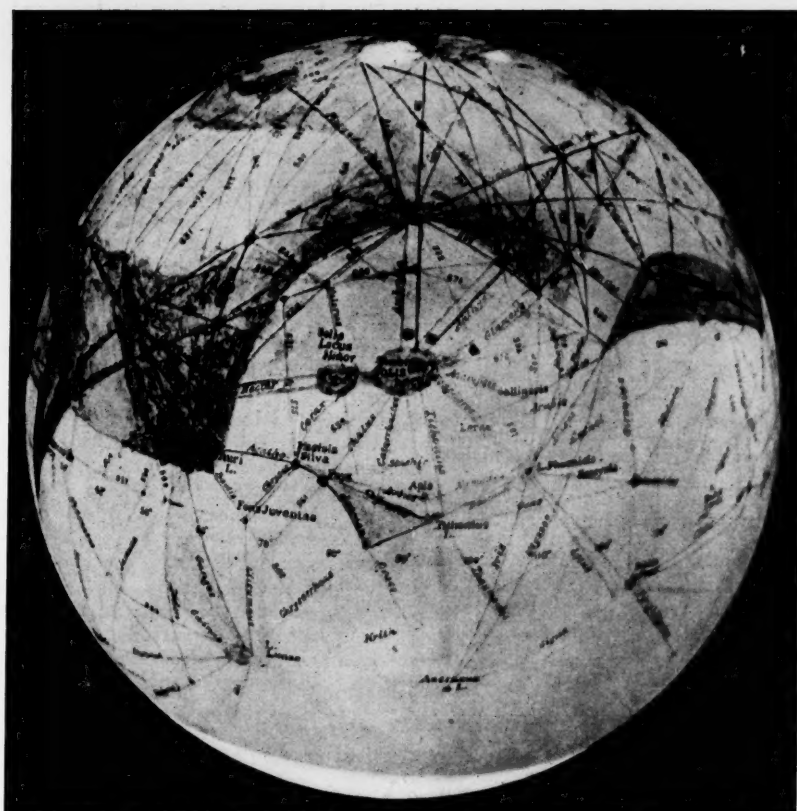
across the deserts to the more fertile maria.

Many scientists see little reason to believe the markings to be constructed by any form of intelligent beings, and argue that they result from natural causes, such as bombardment by small asteroids, causing fissure cracks in the surface in which low forms of plant life similar to our lichen develop and die with the changing seasons. Others have thought them volcanic cracks, glacial tracks, or even rain tracks. Whatever the causes may be, these linear details do appear both visually and photographically.

It is unwarranted for any person, whether he be amateur or professional, to state that since he cannot see Martian fine detail and canals after a few casual observations, such detail is not there. One might politely guess that this is exactly what has happened at times in the past when famous professional astronomers have so stated. If they were actually to set themselves down to observe in earnest with good instruments for a period of several weeks when Mars was well placed, they probably would begin to see at least some of the more prominent and more easily observable canals. This training of the eye and increase of visual acuity through practice cannot be underestimated when studying visually the surface details of the planets.

Mars presents a multiplicity of interesting features for homemade telescopes as well as for large observatory instruments. On our near neighbor we find seasons similar to our own but twice as long, and a sidereal day 41.3 minutes longer than our own. We find great expanses of desert areas, orange-yellow in color, occupying some two thirds of the Martian surface and contrasted sharply with the darkish green and sometimes bluish maria (thought to be seas by the early astronomers).

Brilliant white caps, perhaps of frost, form in the Martian polar regions in



This is the other side of the Mars globe shown opposite. It is centered at Martian longitude 90°, roughly the longitude of the drawing below. South is at the top. Lowell Observatory globe photographs.

late autumn and early winter and begin to melt and evaporate shortly after the Martian vernal equinox. These polar caps never entirely disappear, though in the summer they seem very small and dull, being then obscured by white clouds. Sublimation is perhaps much more extensive on Mars than on the earth, much of the polar snow changing directly from the solid to the gaseous state.

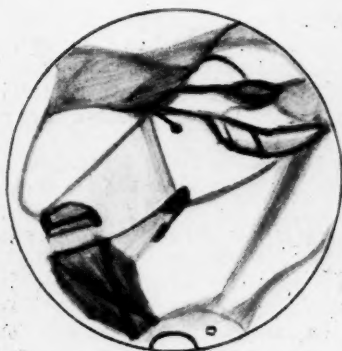
As we watch the polar caps diminish in size with advancing spring and summer, we note that the maria, which have been faded and brown in color, now darken and assume a green and sometimes bluish tone, strong evidence indeed of a growth of some type of vegetation.

White and yellow clouds are often seen high in the Martian atmosphere and may appear on any part of the surface, but seem to have a strong affinity for certain areas. These are often scarcely visible near the central areas of the planet but become prominent near the limb and terminator, occasionally projecting onto the dark sky or night side of the planet. Measurements indicate that some of these clouds rise to altitudes of more than 20 miles above the Martian terrain and are carried over the planet's surface by moderate winds of from four to 25 miles per hour. The surface atmospheric pressure is most probably com-

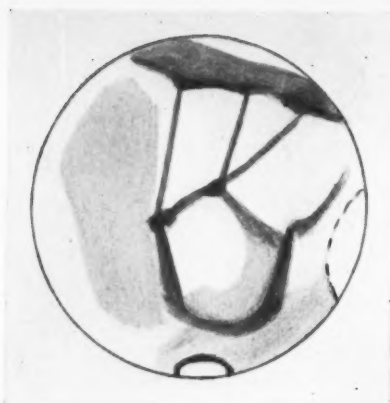
parable to our terrestrial atmosphere at elevations of about 30,000 to 45,000 feet.

Every two years and two months Mars reaches opposition, but due to the high eccentricity of the orbit it varies greatly in its distance from the earth at opposition, from 35 million miles when closest to 63 million miles when most distant. Oppositions, at Mars' perihelion, when the planet is closest, always occur in late summer, and we then see the southern hemisphere of the planet tilted toward the earth by about 20 degrees, but the planet is also then far south in the ecliptic path and not so favorably placed for telescopic observers in the earth's Northern Hemisphere. Oppositions at aphelion, when Mars is farthest, occur when the planet is well north in the ecliptic path and its northern hemisphere is strongly tilted toward the earth; these always occur in late winter, and observers in our northern latitudes experience much less difficulty from bad seeing, because the planet then rides much higher in our skies. The apparent angular diameter of the planet's disk varies from 25 seconds of arc when nearest to 13½ seconds of arc when Mars is at a most distant opposition.

The period of months before and after an opposition, when Mars may be reasonably well observed telescopically, is



Mars, as drawn by the author at Lowell Observatory, 6:45 UT May 25, 1952, central meridian 70°. A power of 550 was used with the 24-inch refractor; Mars was 16 seconds of arc in apparent diameter.



A 12½-inch reflector at 380x and 600x was used by the author while making this drawing of Mars on April 1, 1952, at 8:10 UT. Mars' diameter was 13.5 seconds, central meridian 204°.

usually called an apparition of Mars. The observer will normally expect to see more and recognize finer detail during the more favorable apparitions, when Mars is much closer to the earth, but considerable detail may be seen even during a very distant and unfavorable apparition.

Through the writings, photographs, and drawings of many competent observers, our neighboring planet becomes increasingly interesting. From them we conclude that Mars is a cold sphere not unlike our earth, with an atmosphere, rarefied but existent, ice and snow caps and some form of vegetation, large areas of desert land, no prominent mountains, a wide range of temperatures from noon to midnight, no extended bodies of water, but with linear detail stretching across the deserts sometimes for thousands of miles.

To the amateur with his limited equipment Mars may be just as interesting and exciting an object as to the professional astronomer in a large observatory.

PLEIONE — A STORY OF COSMIC EVOLUTION

(Continued from page 245)

a stationary shell and one that blows off.

Another riddle is presented by Merrill's discovery that the explosive outward motion is best measured in those hydrogen lines that are close in the spectrum to the so-called Balmer limit. It is not present in $H\alpha$ and $H\beta$. Yet, we know that in some other stars, for example, in Deneb (α Cygni), it is $H\alpha$ that shows the escape of the outermost hydrogen atoms, while the other lines do not. We have thus previously believed that in the light of $H\alpha$ we observe only those strata of a gaseous layer that lie on the surface of Pleione's shell, while the lines near the Balmer limit come from great depths inside the layer. Hence, it seemed reasonable that $H\alpha$ would show

First, he may observe what he wishes and as often as he may find time. He is not committed to a definite prearranged program of research. Few professionals have the opportunity to do much planetary work, and to observe Mars and become an experienced observer of the planet requires considerable time and patience — and not necessarily large telescopes.

Probably a really excellent 12-inch reflecting telescope will show on occasions of fine seeing about 90 per cent of all visible detail on the surface of Mars. The remaining 10 per cent will be mainly fine details in the maria and narrow canals and oases. It is also true that a very large portion of the detail within range of a fine 12-inch reflector can be perceived even with a 6-inch instrument provided it is of very high optical quality. Remember that Williams, the second man to see the Martian canals, accomplished this with a 6½-inch reflector. Undoubtedly his telescope was of no better optical quality than at least some of the homemade and professionally made mirrors of today. Therefore, the amateur who begins in earnest to observe Mars, not for a few days each apparition near the time of opposition, but for at least a few months both before and after the opposition date, will gradually, and unconsciously at first, train his eye to see more and more actual detail on the disk of Mars.

He can expect to see only a very small amount of detail when he makes his initial observations. The polar caps are decidedly the easiest objects, then the most prominent maria. First views of Mars are always disappointing, but with a little practice in observing the planet from night to night the beginning observer will soon see much finer details. During the current apparition, Mars presented an angular diameter of only 16.8 seconds of arc on May 8th, when closest to the earth. The 1954 and 1956

the escape of the atoms, while the other lines would record only the existence of a blown-up chromosphere.

Merrill cautiously poses the question: "Is the effective level of formation of the dark hydrogen lines near the limit of the Balmer series higher than that for lines of greater wave length?" And he promises "to discuss this interesting question in future papers." In the meantime he even more cautiously adopts the following order of increasing height of origin of the various spectral lines in the shell of Pleione: (bottom) $H\alpha$, $H\beta$, $H\gamma$, nickel, iron, $H15$, titanium, chromium, $H25$ (top).

There is no question that the observational results agree with Merrill's conclusion. Yet, it is difficult to suppose that $H\alpha$ is really produced at a lower level than $H25$. To the present writer another explanation, also hinted at by



An 8-inch reflector at 350x was used by the author while making this drawing of Mars on June 2, 1952, at 4:55 UT. Mars' diameter was 15.4 seconds, central meridian 330°.

apparitions will be much more favorable, although the planet will not be as high in the southern sky.

From personal experience in observing Mars at every apparition since 1937, the writer would recommend that the beginner use nothing smaller than a 6-inch reflector of reasonably long focus, at least 48 inches or longer, or a 4-inch refractor of $f/15$. Mars is normally best seen with magnifications of 200x or more, but even experienced observers of Mars seldom use magnifications above 500x, regardless of the apertures of their telescopes. Some observers prefer to use an orange or amber filter over the eyepiece to increase contrasts and in larger instruments to dim somewhat the glare of the bright disk.

General interest in the several fascinating problems of Mars and its canals has considerably increased in recent years. Once the amateur has begun to observe the planet seriously, he will find no other field of observational astronomy as interesting and intriguing.

Merrill, appears the more probable one:

The Doppler effect of the explosion is essentially recorded by unsymmetrical, violet-displaced absorption wings of the hydrogen lines. These wings should be stronger in $H\alpha$ than in $H25$. But relatively even stronger are the $H\alpha$ emission components, on both sides of these complex absorption lines. The violet component of $H\alpha$ emission, though not as strong as the red component, may thus completely obliterate the violet absorption wing. In the other hydrogen lines, especially at $H25$, the emission is negligibly faint, while the absorption wings, though not as strong as in $H\alpha$, are still easily visible.

This rather technical detail may appear superfluous to the reader. Yet, upon it hinges the acceptance or rejection of the entire theory of shell formation and shell destruction.

BOOKS AND THE SKY

ASTROPHYSICS

J. A. Hynek, editor. McGraw-Hill Book Company, Inc., New York, 1951. 703 pages. \$12.00.

THE BOOK under review represents a new and interesting departure in the field of astronomical publications that may start a trend in the preparation of astronomical textbooks. The idea for the volume, the editor states in the preface, grew out of casual conversation on the occasion of the 50th anniversary of the Yerkes Observatory that centered around the appropriateness of a review of the progress of astrophysics during the last half century. Fifteen specialists have contributed the 14 chapters. To each author was assigned the task "to survey his field, to describe its growth during the past fifty years, to examine its particularly challenging problems." The book is addressed to a "hypothetical graduate student well versed in fundamentals, but by no means a specialist."

This is not purely a volume commemorating the Yerkes Observatory, yet in a sense it does that, for not a small part of the advances discussed have originated at that institution. It is not primarily a symposium volume, dealing with only certain aspects of specialized fields, yet it has somewhat the flavor of such a publication. It is not a graduate textbook in astrophysics; the number of subjects treated is too large and generally the treatment of each is too limited to qualify the book strictly as such a text. Yet in many ways it does fill a definite need for a modern text that deals briefly with important subjects in astrophysics. The present reviewer has, in fact, made rather frequent use of parts of it during recent months as one text in an introductory astrophysics course of seniors and beginning graduate students at the University of California at Berkeley. Those sections of the book used have been found uniformly excellent.

The subject matter is divided into four large sections having titles and authors as follows:

I. Spectroscopic Astrophysics: P. C. Keenan and W. W. Morgan, L. H. Aller, Otto Struve, P. Swings, Bengt Stroemgren.

II. Physics of the Solar System: Edison

GEOLOGY APPLIED TO SELENOLOGY

By J. E. SPURR

"This is the first time that lunar features have been studied carefully by one trained and experienced in modern structural and igneous geology."—*Journal of Geology*.

Vols. I and II combined, **FEATURES OF THE MOON**, 1945, 430 pp., 95 text figures\$ 5.00
Vol. III, **LUNAR CATASTROPHIC HISTORY**, 1948, 253 pp., 47 text figures ..\$ 4.00
Vol. IV, **THE SHRUNKEN MOON**, 1949, 207 pp., 36 text figures\$ 4.00
Complete Set\$12.00

ROBERT A. SPURR
Box 413, College Park, Maryland

Pettit, N. T. Bobrovnikoff, G. P. Kuiper.

III. Physics of Binary and Variable Stars: G. Van Biesbroeck, J. A. Hynek, Newton L. Pierce, Cecilia Payne-Gaposchkin.

IV. Physics of Cosmic Matter: Jesse L. Greenstein, S. Chandrasekhar.

The scope of the subject matter discussed by these distinguished authors, each a specialist in his own field, is very great; it would be highly presumptuous of one individual to attempt a critical review of each article. One can at best, perhaps, list a few impressions that remain after a careful reading of the entire volume.

As a whole, the book leaves an excellent impression; the contributors have generally surveyed their fields very satisfactorily. The multiplicity of authors has led inevitably to some unevenness of coverage in the different chapters. In some instances the writing may not be on a sufficiently high level for the hypothetical graduate student mentioned in the preface. Less frequently it appears that the graduate student would have difficulty following some greatly condensed argument.

Chapter 1, Classification of Stellar Spectra, by Keenan and Morgan, is disappointingly brief. Discussions of the problems of spectral classification on a level for graduate students and by two recognized authorities are rare. Additional topics would be welcome in this short paper, as would more detailed discussion of those topics considered.

Chapter 9, Visual Binary Stars and Stellar Parallaxes, by Van Biesbroeck, also might be placed in the category of "too short chapters." Modern photographic and interferometer measurements of double stars and the results obtained from such measurements are mentioned only very briefly, as are the particular uses and limitations of these methods. There is no discussion of the present status of trigonometric parallax observations and of the continuing importance of such programs—not those designed in the traditions of the past, but those planned from a modern point of view in which emphasis is placed on stars of particular importance to present astrophysical problems. The present decline of interest in parallax work may seriously handicap the future development of some branches of astronomy. This chapter could well be brought up to date in a number of ways.

Chapter 7, Comets, by Bobrovnikoff, might profitably have been shortened by the omission of excess descriptive detail, definitions, and speculative hypotheses of low probability.

While in some other chapters there may exist slight blemishes of the general type pointed out above, the great majority of the contributions are excellent. It is, in fact, very difficult to rate them in any order other than one of purely personal preference. In any event, one cannot fail to appreciate the excellent discussions and summaries of much material not readily found elsewhere (as in the discussions by Stroemgren, Kuiper, and Greenstein), the many suggestions for problems in need of further work (as in the chapter by Swings), and the general bringing of cal-

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Harvard Observatory, Cambridge 38, Mass.

culations up to date by use of the latest and best numerical values.

Astrophysics is a volume of great value that should find wide circulation among both students and professional research workers in astronomy. It is to be hoped that it may be the first of a series that will deal with all the major fields of astronomy.

HAROLD F. WEAVER
Leuschner Observatory

THE STARS A New Way To See Them

H. A. Rey. Houghton Mifflin Company, Boston, 1952. 143 pages. \$4.00.

AS THIS BOOK moves onto the nation's library shelves, I predict it will become one of the most popular educational works of the year. In a world that is becoming astronomy conscious, it provides the answer for those who ask: "Where can I find a good book about the stars that a layman can understand and enjoy?"

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Greenwich, London, S. E. 10, England

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Harvard Observatory, Cambridge 38, Mass.

The author has discarded the methods normally employed in teaching star recognition and elementary astronomy. There are no introductory chapters on the solar system or star magnitudes and distances which are discouraging to the person who gingerly sticks his toes into the sea of astronomical knowledge. The opening paragraph of Mr. Rey's book reads:

"This book is meant for people who want to know just enough about the stars to be able to go out at night and find the major constellations, for the mere pleasure of it."

One hundred and thirty-six pages later, however, one should have a working knowledge of the science comparable to that of many amateur astronomers who learned the hard way.

The Stars is divided into four parts: "Shapes in the Sky," "Meet the Constellations," "The Stars Through the Year," and "Some Whys and Hows." Never allowing himself to become bogged down with difficult explanations, the author neatly sidesteps these pitfalls by such words as, "We'll take this up again on page 128." By the time you reach that page you are ready for it.

Gone are the meaningless geometric shapes we have used to represent such groups as the Twins, the Lion, or the Little Bear. Also gone are the mythological figures arbitrarily drawn around various groups of stars. Mr. Rey's ability to draw straight lines between stars is so simple it is unbelievable. The Twins now actually look like twins holding hands; Hercules becomes a man holding a club; Cetus turns out to be a reasonable likeness of a whale; Bootes is a funny little herdsman with peaked cap and pipe. Dozens of these sketches offer an entirely new concept of the heavens above us. In three weeks of experimenting, I find myself discarding the shapes I have always known in favor of this artist's lovable creatures. Moreover, I have identified constellations heretofore beyond my powers of comprehension.

In Part Two, the constellations are fitted into their proper places by the same down-to-earth logic. Writing for observers in the Northern Hemisphere, the author classes certain groups as animate: the Winged Horse, the Herdsman, the Bull, and the Hunter. Farther south are the "wet" groups, such as the Fishes, Whale, Water Snake, and Water Carrier. Forsaking Latin, Greek, and Arabic terms, English translations of the constellation titles are used throughout, while the original names are in parentheses for reference.

By the time the reader reaches Part Three, there is no difficulty in following the 12 calendar charts with explanatory footnotes and diagrams to enable him to fit his observing to the clock. These must be tried to prove their effectiveness. Words cannot describe the clear, concise teaching methods involved.

The "Whys and Hows" of Part Four prove that by use of abundant sketches, cartoons, and clever artistry, learning the fundamentals of astronomy can become a delightful experience.

A review of this work would be incomplete without describing the jacket. Printed on heavy paper, it unfolds to become a 22-by-25-inch "General Chart of the Sky"

suitable for mounting on the wall of library, den, or observatory. Segments of the map are identified as to the hour and date each constellation can best be seen.

Here is a book you can recommend, without reservation, to anyone between the ages of eight and 80 who can read. My early apprehension that it would prove difficult to interpret conventional sky maps after having seen them through Mr. Rey's eyes proved unfounded. The trend will be reversed by most readers, for I now convert the usual constellation images into "the new way to see them."

CHARLES H. LeROY
Group Projects Chairman
Astronomical League

PALOMAR

The World's Largest Telescope

Helen Wright. The Macmillan Co., New York, 1952. 188 pages. \$3.75.

FOR SEVERAL YEARS Helen Wright has been collecting material for a biography of George E. Hale, working with the co-operation of his former associates on the staff of the Mount Wilson and Palomar Observatories. This close contact with the surroundings in which Hale's final dream was given reality, and with the men who helped to realize it, has put Miss Wright into an admirable position to write also the story of the building of the telescope itself.

The story is well told and well documented, from the first tentative negotiations between Hale and the Rockefeller Foundation to the dedication of the completed instrument and the initial observations at Palomar Observatory. The frank extracts from the records revealing the initial disagreements between the Rockefeller Foundation and the Carnegie Institution over the question of who was to administer the gift show how close the whole project was to foundering at the start. It was Wickliffe Rose of the International Education Board of the Rockefeller Foundation whose enthusiastic support did much to induce the board to grant \$6,000,000 for the project, while Henry M. Robinson of the California Institute of Technology stepped in at a critical moment with a personal guarantee of the additional funds needed for the initial operating endowment.

From these negotiations the account turns to the years spent in casting the disk, in figuring the surface to a precision of two-millionths of an inch, and in erecting the great tube and dome on 5,500-foot Palomar Mountain—the Place of the Dove. Throughout the story the reader never forgets the high degree of co-operation by hundreds of people that made it possible to overcome the formidable difficulties involved in the unprecedented task.

This straightforward account of a true scientific adventure should hold appeal for a wide variety of people, for interest in Palomar is world wide. If the publishers had emulated such series as the King Penguin books, which are able to offer equally well-illustrated volumes at a price of less than a dollar, the market for the work could easily be very great. As it is, the price seems high for such a small book.

PHILIP C. KEENAN
Perkins Observatory

GLEANINGS FOR ATM's

EDITED BY EARLE B. BROWN

HOW TO MOLD AND POUR YOUR OWN CASTINGS — II

IN ORDER to prove the simplicity of my new technique for molding castings, I gave a demonstration before a group of amateur telescope makers in the workshop of the Amateur Astronomers Association at the Buhl Planetarium in Pittsburgh. To my own gratification, one of the amateurs who had never had any previous molding experience made a very fine casting after watching the demonstration.

In August, 1951, I installed the molding equipment in the workshop at the Buhl Planetarium, where Dr. Joseph Laughrey, a prominent Pittsburgh physician, became the chairman of the molding committee. He and Leo N. Schoenig, supervisor of the workshop, have done a commendable job in helping amateurs improve their molding techniques. On this month's front cover they are pictured examining one of the castings; on the table in front of them are most of the essential parts of the molding equipment described last month. The furnace and crucible are shown in an additional illustration below.

Here is the procedure for making your own aluminum and brass castings. It's as simple as baking a cake! Just remember not to be like the brand-new bride who was completely crushed because her first cake was a failure. Just remember that many persons have used this molding technique with great success — eventually.

First, prepare the molding sand by wetting it with water, mixing it thoroughly in the sandbox. Use extreme care in the amount of water, for the sand should be just wet enough to hold together. Don't use too much water. The less you use, the less flash steam there will be later.

Second, lay the molding board on the table or bench which you have chosen as your working spot. Place the drag on the molding board, putting the side of the drag that matches the cope face downward.

Next, place your pattern in the drag; then put the trap pattern 1" away from the pattern. Put a handful of molding sand in your sifter and sift $\frac{1}{8}$ " of sand over the patterns and inside the bottom of the drag. Now continue to fill the drag with sand, packing it in with your fingers, until the drag is full. With the ramming tool, ram the sand; then use the striking stick to make the sand level with the top of the drag.

Now you can reverse the drag and its contents on the molding board and mount the cope on top of the drag. Sprinkle a thin film of the white lake sand from the shaker over the surface of the sand already in the drag. Then place the four riser patterns around the other patterns, about 1" distant from them, pushing each riser pattern into the sand about $\frac{1}{2}$ " deep. Space the riser patterns 90° apart and in vertical positions.

Put a handful of molding sand in the sifter and sift about $\frac{1}{8}$ " over the face of the drag. Now fill the cope with molding sand, packing it in with your fingers and with the rammer. Level off the top of the cope with the striking stick.

At this point, fill your eye-dropper with water and put a few drops around each riser pattern. Jiggle each riser pattern gently, and remove them all from the sand. Carefully lift the cope from the drag — keeping it in a vertical position — and place the cope on the floor.

Caution: Never bump or vibrate the cope or the drag after you have rammed the sand well into them. Handle with the utmost care!

Fill the eye-dropper with water again and put a few drops around the remaining patterns. Now is the time to use your trowel to make the "gates" or "gutters" between the riser holes in the sand and the patterns. Next, hammer a 1" brad about $\frac{1}{4}$ " deep into each of the patterns. Tap each pattern very lightly and carefully



The furnace and crucible used in the casting projects at the workshop of the Amateur Astronomers Association of Pittsburgh. The photographs with this article are by Messrs. Winterhalter, Schwartz, and Rachuba, members of the Pittsburgh society.

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Mr. Raible lifts the crucible of molten metal from the furnace, while Dr. Joseph Laughrey, right, holds the lid of the furnace.

wiggle it out of the sand with a vertical lift. Inspect your molds for any defects before you proceed, and repeat whatever steps are necessary to get perfect results.

Now turn to the furnace, into which you have already placed the crucible. Put your scrap metal into the crucible. Light the gas in the furnace, start the fan, and then place the lid on top of the furnace. Flames six or eight inches high should shoot out between the lid and the furnace. After the furnace has been in operation about 15 minutes, remove the lid with care, placing it on the fire bricks already arranged for the purpose. If the metal is completely melted, stir the liquid with the slag remover, which should be preheated for this operation. Take off any slag that gathers on top of the liquid metal.

Place the drag on the floor and put the cope on top. You are ready to pour the hot metal. Shut off the gas and use the pouring tongs to remove the crucible from the furnace, as pictured here. Pour steadily at a moderate rate, avoiding jerky stops and starts.

Pour into the hole that connects with the trap; this is the "pouring head." The metal will run from the trap into the recess made by the pattern and from there up into the riser holes. You will know the pouring is complete when you see the liquid metal appear at the top of the riser holes in the cope. Stop then, and if

there is any excess metal remaining in the crucible, pour it into a prepared place in the molding sandbox. Put the hot crucible back into the furnace, allowing the blower to cool both the furnace and crucible before you shut it off.

Allow the mold to cool about half an hour before you remove the cope from the drag to inspect your casting. Well, how'd you do?

It is hoped that these instructions, prepared with the help of Betty Knox, will be of use in the creation of more efficient amateur telescopes. I shall be glad to answer questions from any amateur groups regarding pattern making and molding.

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OBSERVER'S PAGE

Universal time is used unless otherwise noted.

DOUBLE STAR TESTS FOR SMALL TELESCOPES

PERHAPS the simplest and most quantitative test of a telescope under actual operating conditions is its ability to resolve close double stars. Other tests are available, such as the appearance of the diffraction ring system in a star image or resolution of planetary and lunar detail, but these criteria are somewhat subjective and require considerable experience in interpretation. A double star test is rather positive in that it gives a simple "yes or no" answer; either the star is resolved or it is not. Theory and experiment are in agreement in predicting that a first-class telescope of aperture A inches should resolve a double star whose components are separated by $4.56/A$ seconds of arc, provided the stars are moderately bright and not too unequal in magnitude. Table I shows the theoretical resolving power of a number of popular-sized instruments.

Aperture in inches	Resolving Power in seconds of arc
2	2.28
3	1.52
4	1.14
5	0.91
6	0.76
8	0.57

The principal difficulty in applying a double star test is the finding of suitable pairs whose separations are accurately known. Pairs close enough to provide real tests even for small telescopes are apt to be binary stars in rapid relative motion, with separations changing from year to year. Thus, tests based on out-of-date double star lists from atlases and observing handbooks may be quite misleading. In the course of testing several instruments, the writer scanned the famous double star catalogues* of Aitken and Burnham for appropriate bright pairs for which the data are concordant and which either show no motion or are moving slowly and in a predictable fashion. As a result of this work, the graduated list of Table II was compiled. The writer is greatly indebted to Dr. H. M. Jeffers, of Lick Observatory, for supplying him with the most recent reliable measures of most of the pairs in this list.

Each of the stars in the table may be found in Norton's *Star Atlas* under the designation used here. To facilitate location of the stars, the 1950 co-ordinates are given. In each case the best available data have been plotted and extrapolated to give the position angle and separation of the pair both in 1952 and in 1967, so the list should be useful for the next 15 years. Where the data show no evidence of motion, no position is given for 1967.

In testing a telescope, it is essential to select a night when the atmospheric conditions are favorable, as evidenced by the presence of steady diffraction rings around the images of bright stars. It is also

necessary to use sufficient magnification to insure that it is the telescope which is being tested, rather than the visual acuity of the observer. A power equal to 50 times the aperture in inches is probably the least that is really adequate. With reflecting telescopes of the usual focal ratios, the most satisfactory way of obtaining high powers is to employ a Barlow lens, rather than to go to eyepieces of uncomfortably short focal lengths. In spite of the criticisms sometimes made of reflectors, the writer has found little difference in the performances of first-rate reflectors and refractors of comparable aperture.

A double star near the theoretical limit of the telescope (Table I) should appear as two neat disks verging on contact with each other. Pairs with greater separations should be cleanly resolved into well-separated images, while those with separations less than the theoretical limit will merge into "figure eights," ellipses, and finally into circles showing no evidence of duplicity. On very fine nights these appearances can be held steadily, but on ordinary nights they may be seen only in glimpses when the air is momentarily quiescent.

As an instructive experiment which is useful in educating the eye, the sequence of images mentioned above may be viewed in rapid succession by focusing the telescope on a suitable double star and reduc-

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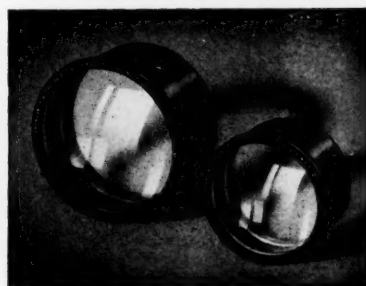
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*Robert G. Aitken, "New General Catalogue of Double Stars," Carnegie Institution of Washington, 1932.

S. W. Burnham, "A General Catalogue of Double Stars," Carnegie Institution of Washington, 1906.

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TABLE II — A GRADUATED LIST OF DOUBLE STARS

Star	1950 Co-ordinates		Mags.	Position Angle		Separation		Notes
	R.A. h m	Dec. ° ' "		1952 ° ' "	1967 ° ' "	1952 " "	1967 " "	
ε ₁ Lyrae	18 43	+39 37	4.6, 6.3	2 359		2.87	2.84	1
1 Arietis	1 47	+22 02	6.2, 7.4	166		2.78		
Σ 2245	17 54	+18 20	7.0, 7.0	293		2.62		
ε ₂ Lyrae	18 43	+39 34	4.9, 5.2	104 97		2.34	2.43	1
ν Scorpil BC	16 09	—19 21	7.0, 8.0	48		2.13		2
Σ 2624	20 02	+35 53	7.2, 7.8	173		2.00		3
33 Orionis	5 29	+3 15	6.0, 7.3	26		1.93		
Σ 1871	14 40	+51 37	7.0, 7.0	302 304		1.86	1.87	
Σ 644	5 07	+37 14	6.7, 7.0	221		1.66		
57 Cancrī	8 51	+30 46	5.9, 6.4	318 316		1.45		
π Aquilae	19 46	+11 41	6.0, 6.8	109 107		1.40		
Σ 2054	16 23	+61 48	5.7, 6.9	354 353		1.24	1.27	
ξ Cancrī AB	8 09	+17 48	5.0, 5.7	21 339		1.10	1.12	4
OΣ 384	19 42	+38 12	7.0, 7.3	195		1.03		
16 Vulpeculae	20 00	+24 48	5.8, 6.2	112 114		0.83	0.86	
51 Aquarii	22 22	—5 06	6.7, 6.7	329 319		0.67	0.70	
β 302	0 56	+21 08	6.7, 8.1	129 139		0.59		

Notes: 1. ε₁ and ε₂, separated 208", form the famous "double-double."

2. This is the fainter and wider pair of a quadruple similar to ε Lyrae. The brighter pair has a separation of about 1", but the measures are very discordant.

3. There is a 9.5-magnitude star at 327° and 43".

4. This is a binary reaching aphelion in 1960, when the separation will be 1".15. There is a 5.5-magnitude star at 98° and 5".5.

ing the aperture with successively smaller stops. If a bright and fairly wide pair, such as γ Virginis, is chosen, the experiment may be performed with low powers and small apertures, and the images will be steady even under mediocre atmospheric conditions.

In comparing Tables I and II, note that ε Lyrae is a real test only for objectives of two inches and under, although appar-

ently this quadruple star has been used rather indiscriminately as a criterion for all small telescopes. The writer distinctly recalls having seen a 10-inch mirror advertised for sale on the strength of having resolved these pairs!

ALEX G. SMITH
Dept. of Physics
University of Florida
Gainesville, Fla.

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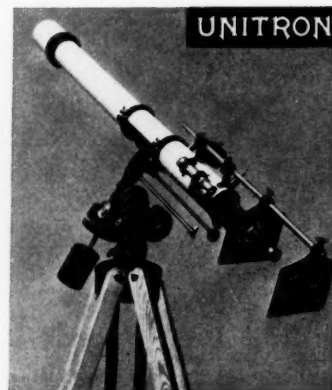
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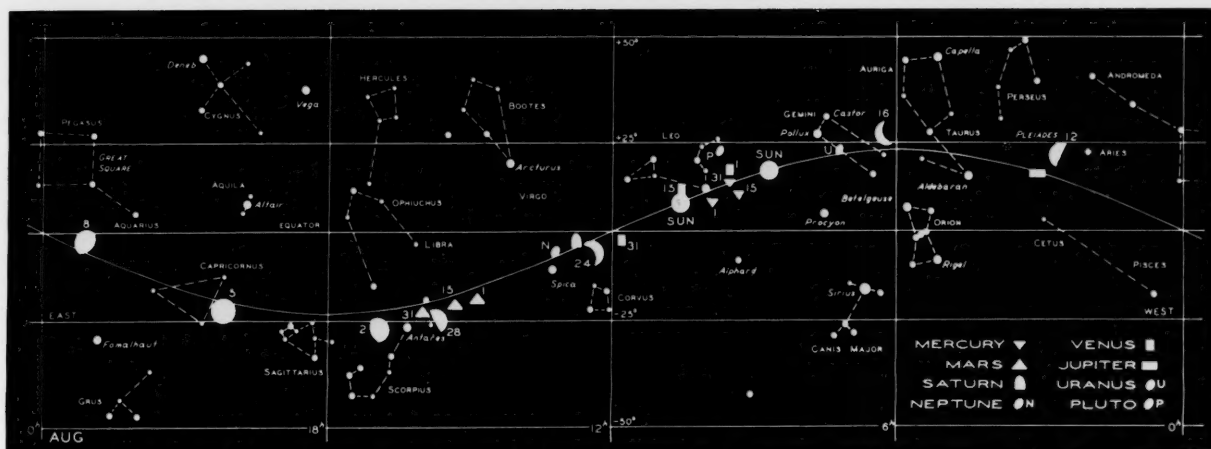
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THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Sun. The second solar eclipse in 1952, this one annular, takes place on August 20th. The path of the annular phase crosses South America and the cities of Lima and La Paz. Partial phases may be seen from South America, most of Central America, and the West Indies. The maximum duration of annularity is six minutes 41 seconds; its length results partly from the fact that the moon is near apogee.

Moon. The moon undergoes partial eclipse on August 5th, an event visible chiefly from the Eastern Hemisphere. The magnitude of the eclipse is 54 per cent, with a total duration of four hours 42 minutes. Perigee occurs the same day, when the moon makes its closest approach to the earth this year. The full moon that night will be at its largest apparent size, and it will be noticeably brighter than usual.

Mercury, a morning star after August 12th, comes to elongation on the 30th, 18° 11' west of the sun. Rising 1½ hours before the sun, Mercury appears at about zero magnitude.

Venus may be viewed in the evening sky after an absence of a year. Look low in the west a few minutes after sunset to see

the brilliant planet, at magnitude -3.4.

Mars comes to eastern quadrature with the sun on August 16th, setting well before midnight. After traveling eastward through Libra, the planet enters Scorpius late in the month, where it may be seen not far from Antares, but a magnitude brighter than the star. Telescopically, the Martian disk is 9".3 in diameter on the 15th, still a good object under high power.

Jupiter rises as Mars sets (in mid-month), with western quadrature for the giant planet on August 12th. Jupiter is once again an excellent object for a small telescope, with an equatorial diameter of 41" and its familiar retinue of satellites.

Saturn is low in the southwest after sunset. This will be the last opportunity for viewing Saturn in the evening sky this year. The ring system is inclined 8° to our line of sight, with the northern face visible.

Uranus rises before morning twilight, as a 6th-magnitude object. It is moving eastward about a degree west of Delta Geminorum.

Neptune is difficult to view, as it is very low in the southwest after evening twilight ends.

E. O.

AUGUST METEORS

Enthusiasts of meteor observing generally choose this as their favorite and most profitable month. Outstanding is the Perseid display for the first half of August, the peak occurring about the 12th, with 50 to 70 meteors per hour seen by one observer under favorable conditions after midnight. The maximum is considered to extend from the 9th to the 13th. The radiant is north of Eta Persei and of the diffuse and moving type. Perseids are

UNIVERSAL TIME (UT)

TIMES used on the Observer's Page are Greenwich civil or Universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the UT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown. Add one hour for daylight-saving time.

very swift except for those close to the radiant, and many are bright and train-leaving.

The moon will interfere somewhat, as it is at last quarter on the 12th, moving south of the radiant. It will rise shortly before midnight during the Perseid maximum.

E. O.

MOON PHASES AND DISTANCE

Full moon	August 5, 19:40
Last quarter	August 12, 13:27
New moon	August 20, 15:20
First quarter	August 28, 12:03
Full moon	September 4, 3:19

	August	Distance	Diameter
Perigee	5, 20 ^h	221,900 mi.	33' 28"
Apogee	19, 11 ^h	252,500 mi.	29' 24"
September			
Perigee	3, 6 ^h	222,700 mi.	33' 20"

VARIABLE STAR MAXIMA

August 18, T Columbae, 7.6, 051533; 19, RR Scorpii, 6.0, 165030; 23, R Bootis, 7.3, 143227; 24, RV Centauri, 7.6, 133155; 31, RS Librae, 7.7, 151822. September 1, R Hydrae, 4.6, 132422; 2, V Monocerotis, 7.1, 061702; 4, R Octantis, 7.9, 055686.

These predictions of variable star maxima are by the AAVSO. Only stars are included whose mean maximum magnitudes are brighter than magnitude 8.0. Some, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

MINIMA OF ALGOL

August 2, 4:25; 5, 1:14; 7, 22:03; 10, 18:51; 13, 15:40; 16, 12:28; 19, 9:17; 22, 6:05; 25, 2:54; 27, 23:43; 30, 20:31. September 2, 17:20; 5, 14:08.

These predictions are geocentric (corrected for the equation of light), based on observations made in 1947. See *Sky and Telescope*, Vol. VII, page 260, August, 1948, for further explanation.

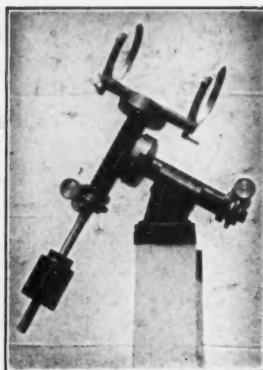
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NEW COMET PELTIER

Leslie C. Peltier, of Delphos, Oh'o, who is well known as a discoverer of comets, found another one on June 20th. It was of the 10th magnitude, located at right ascension 14h 40m, declination +68°, in the constellation of Ursa Minor.

On the basis of observations of the comet by H. L. Gelas, Lowell Observatory, and G. Van Biesbroeck, Yerkes Observatory, an orbit has been computed at the Leuschner Observatory, University of California, and transmitted by Dr. L. E. Cunningham. The comet passed perihelion on July 14th, at a distance from the sun of 1.2 astronomical units.

The following positions are predicted, 1952 co-ordinates, with right ascension given after the date, then declination:

July 17.0, 15:59.3, +72-45; 27.0, 16:58.0, +72-54. August 6.0, 18:05.8, +71-10; 16.0, 19:09.8, +66-45; 26.0, 20:01.5, +59-22. September 5.0, 20:40.4, +49-07.

OCCULTATION PREDICTIONS

August 3-4 h Sagittarii 4.7, 19:33.8 -24-59.5, 13, Im: H 9:18.8 -0.9 -0.1 58.

August 12-13 q Tauri 4.4, 3:42.3 +24-19.1, 22, Im: A 5:01.8 +0.1 +1.3 84; B 5:06.2 +0.1 +1.5 78; C 4:57.9 +0.2 +1.2 85; D 5:04.7 +0.3 +1.4 75. Em: A 5:57.7 +0.1 +1.9 235; B 6:03.3 0.0 +1.8 241; C 5:51.6 +0.2 +1.8 235; D 6:00.2 +0.1 +1.7 245; E 5:56.8 +0.3 +1.4 252.

August 12-13 20 Tauri 4.0, 3:43.0 +24-13.2, 22, Im: A 5:23.0 -0.6 +0.6 123; B 5:24.9 -0.4 +1.0 114; C 5:18.8 -0.5 +0.4 124; D 5:21.6 -0.2 +1.0 110. Em: A 5:57.8 +0.8 +2.9 196; B 6:06.3 +0.5 +2.5 205; C 5:51.5 +0.9 +2.7 195; D 6:04.7 +0.5 +2.3 210; E 6:03.4 +0.6 +1.9 219.

For standard stations in the United States and Canada, for stars of magnitude 5.0 or brighter, data from the American Ephemeris and the British Nautical Almanac are given here, as follows: evening-morning date, star name, magnitude, right ascension in hours and minutes, declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, UT, a and b quantities in minutes, position angle on the moon's limb; the same data for each standard station westward.

The a and b quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude, respectively, enabling computation of fairly accurate times for one's local station (long. Lo, lat. L) within 200 or 300 miles of a standard station (long. LoS, lat. LS). Multiply a by the difference in longitude (Lo - LoS), and multiply b by the difference in latitude (L - LS), with due regard to arithmetic signs, and add the results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Universal time to your standard time.

Longitudes and latitudes of standard stations are:

A +72°.5, +42°.5	E +91°.0, +40°.0
B +73°.6, +45°.6	F +98°.0, +31°.0
C +77°.1, +38°.9	G +114°.0, +50°.9
D +79°.4, +43°.7	H +120°.0, +36°.0
I +123°.1, +49°.5	

PREDICTIONS OF BRIGHT ASTEROID POSITIONS

Thyra, 115, 9.5. Aug. 16, 23:51.9 +11-44; 26, 23:46.9 +13-12. Sept. 5, 23:38.5 +14-05; 15, 23:28.2 +14-28; 25, 23:17.5 +14-25. Oct. 5, 23:07.9 +14-01.

Kleopatra, 216, 8.7. Aug. 16, 23:43.9 +16-13; 26, 23:41.0 +15-58. Sept. 5, 23:35.9 +15-09; 15, 23:29.7 +13-48; 25, 23:23.2 +12-00. Oct. 5, 23:17.7 +9-56.

After the asteroid's name are its number and the magnitude expected at opposition. At 10-day intervals are given its right ascension and declination (1952.0) for 0h Universal time. In each case the motion of the asteroid is retrograde. Data supplied by the IAU Minor Planet Center at the University of Cincinnati Observatory.

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WANTED: Good reflector or refractor 4" or larger, or mounting for telescope. Details first letter. Must be reasonable. L. Sannella, M.D., 200 Fourth St., Petaluma, Calif.

NORTON'S "Star Atlas and Reference Handbook," latest edition 1950, \$5.25; "Bonner Durchmusterung," southern parts, \$38.50, northern parts in print; Elser's map of the moon, \$1.50; McCrea, "Physics of the Sun and Stars," \$2.00. All domestic and foreign publications. Herbert A. Luft, 42-10 82nd St., Elmhurst 73, N. Y.

FOR SALE: World's largest Zeiss triplet applanatic objectives binocular. Originally made especially for comet seeking. Objectives 180 mm. (over 7") clear aperture. Two rotating drum eyepieces, one 30x, the other with Goodwin Barlows, permit interchanging of eyepieces (1 1/4" size, yielding up to 150x sharply despite f/5 objectives, which triplet OG's correct to longer primary focal length equivalent. Altazimuth. On sturdy steel tripod. Star diagonals, extra pairs eyepieces. Total weight approximately 300 pounds. Price only \$2,800.00. F. L. Goodwin, 345 Belden Ave., Chicago 14, Ill.

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STARS FOR AUGUST

The sky as seen from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time,

on the 7th and 23rd of August respectively; also, at 7 p.m. and 6 p.m. on September 7th and 23rd. For other times, add or subtract ½ hour per week. When facing north, hold

"North" at the bottom; turn the chart correspondingly for other directions. The projection (stereographic) shows celestial co-ordinates as circles.



